NATURAL ENVIRONMENT

Environment refers to all the things that provide for and preserve life – air, soil, water, plants, animals, and climate. It is the sum of all of the things that sustain and enrich our lives. Environmental conservation means using our resources wisely and protecting the quality of our surroundings for ourselves and for future generations. Environmental degradation can occur from improper use of natural resources including indiscriminate tree cutting, overgrazing by livestock, inadequate control of increased run-off, over-pumping of aquifers, and poor construction and siting of buildings and on-site liquid waste disposal systems or contamination from other sources such as leaking underground storage tanks. The natural environment and scenic beauty of the East Mountain Area is vulnerable to degradation due to the area's unique combination of steep slopes, shallow soils, fractured bedrock, dependence upon groundwater, and the lack of centralized water and sewer facilities.

According to the 2003 East Mountain Area community survey, forest health and environmental issues ranked third among 14 issues of importance to residents. When asked what they liked best about the East Mountain Area, 52 percent of 670 respondents provided comments relative to aspects of the EMA environment. These comments included no light, noise, or air pollution, views and scenery, forests, trees, and "green" vegetation, wildlife, nature, and the mountains. Also, 6 percent were enthusiastic about the weather in that they get more snow and rain, which leads to an increase in vegetation.

WATER

Water is one of the most valuable natural resources for the East Mountain Area. At present, almost all of the domestic, commercial, and agricultural water used in the East Mountain Area comes from groundwater, whether native to the basin or imported from surrounding areas via community water systems. In order to ensure that this groundwater is available for use in the future, the community must take measures to protect this valuable resource.

There are a variety of ways people obtain water in the East Mountain Area. These typically include private wells, community water systems, shared wells, and less frequently, water hauling, and rainwater harvesting. According to the 2003 community survey, there has been a shift from individual wells to community systems for water supply needs. Some people who haul water use it only for drinking water while they use a well or water system for other water needs. However, there are some residents who haul water for all their needs. People who harvest rainwater use it to supplement their well or water system. However, variable precipitation, especially recent droughts, has made this water supply unreliable.

In order to understand the water resources in the East Mountain Area, it is important to examine the entire hydrologic cycle and try to quantify its components. The hydrologic cycle describes how water typically moves through an environment. The cycle is usually described to "start" with precipitation, which falls to the ground in the form of rain and snow in the East Mountain Area. Precipitation evaporates, infiltrates into the ground, or runs off into drainage channels, with some of the drainage evaporating, transpiring through plants, or infiltrating into the ground as well. Recharge represents the part of infiltrating water that finds its way into the portion of a geologic formation saturated with groundwater. If the geologic formation can provide sufficient volumes of useable quality water to wells, it is termed an aquifer. Groundwater moves through a geologic formation at a rate controlled by the permeability of the geologic formation and the steepness, or gradient, of the groundwater surface slope. Eventually, groundwater flows out of the geologic system into springs, streams, evapotranspires, or continues to flow through geologic units to other areas.

In addition to quantifying components of the water cycle, it is important to assess the hydrogeologic properties and groundwater quality, particularly since the majority of water used in the East Mountain Area is withdrawn from the ground. Groundwater quality from the geologic units can vary due to natural differences in the geologic formations and human-caused situations resulting, for example, from contamination by septic tank drain fields or leaking underground fuel storage tanks.

The following sections describe water resources in the East Mountain Area by estimating precipitation and recharge rates, describing hydrogeologic properties of rocks in the area, and assessing water quality in the area.

Surface Water

Perennial streams in the East Mountain Area are few and limited in length, surfacing at springs and flowing short distances. Most surface water is in the form of ephemeral streams that flow only during periods of high rainfall or snowmelt. The riparian areas associated with perennial streams are scarce within the area, and provide habitat not common in the typically arid East Mountain landscape.

There are approximately 39 springs that vary between perennial and intermittent flow. There are three ponds: (1) Pine Lake located in the Sandia Park area, (2) one on the east side of North 14 near San Antonio, and (3) another at Seven Springs along Interstate 40 in Tijeras Canyon.

The East Mountain Area contains several watersheds, by which surface water can flow out of the East Mountain Area. For the purposes of this plan, watersheds were defined as those on (1) west-facing slopes of the Sandia Mountains, (2) west-facing slopes of the Manzanos and Manzanitas, (3) western edge of Estancia Basin, (4), Tijeras Canyon, and (5) San Pedro Creek (Figure 1).

Precipitation

Precipitation in the form of rainfall or snowfall varies in intensity and amount. Seasonally, most precipitation falls in the monsoon season (July, August, and September) and in the winter months. Precipitation also varies greatly based upon elevation and microclimate, as higher elevations generally have higher precipitation amounts. Areas of higher elevations typically have more dense vegetation that

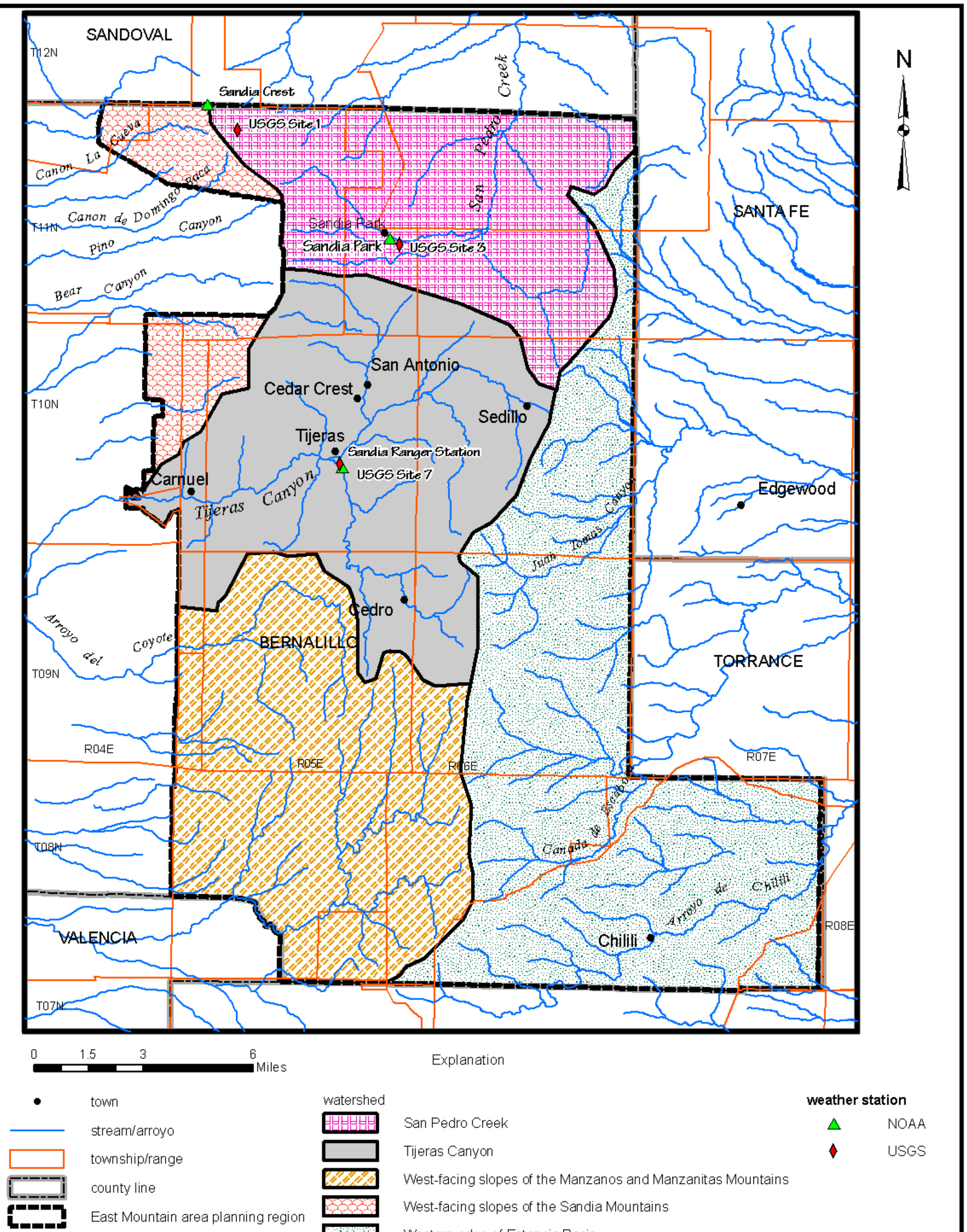


Figure 1. Map showing the major watersheds and arroyos in the East Mountain Area, Bernalillo County, New Mexico.

JOHN SHOMAKER & ASSOCIATES, INC.

retains and collects water, slows water runoff, and allows infiltration back into the soil and aquifers. Most of the higher elevation mountain areas are under the control of the National Forest Service. In addition, precipitation can also vary dramatically from year to year (Figure 2).

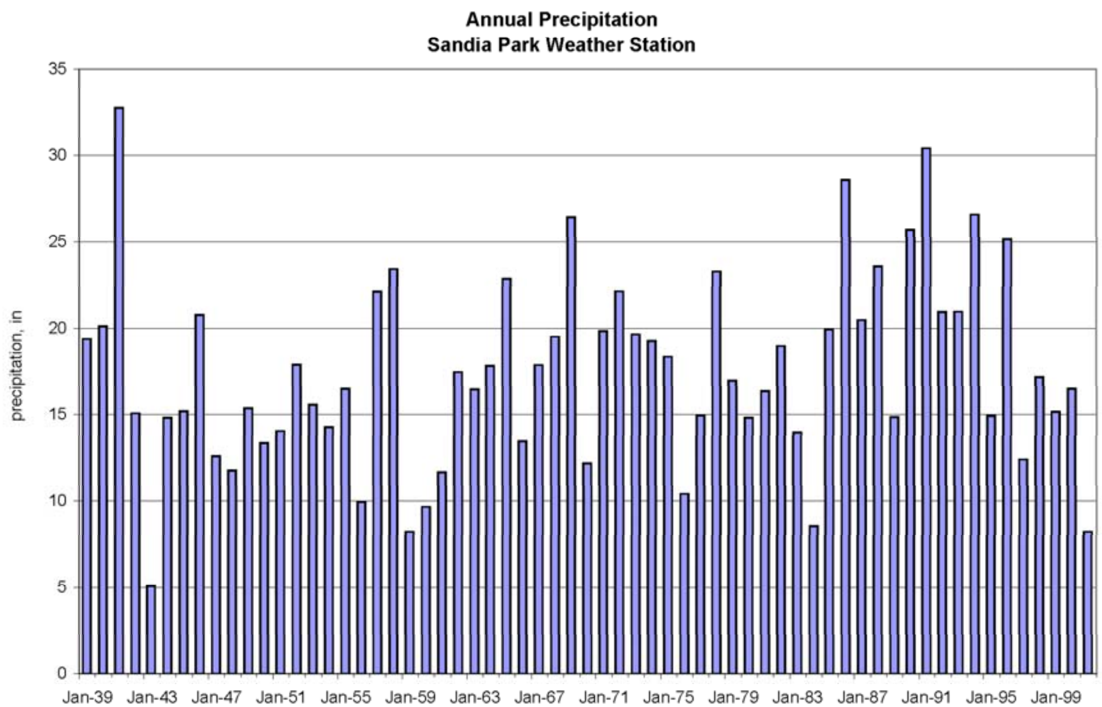


Figure 2. Chart showing variation in annual precipitation at the Sandia Park weather station.

JOHN SHOMAKER & ASSOCIATES, INC.
WATER RESOURCE AND ENVIRONMENTAL CONSULTANTS

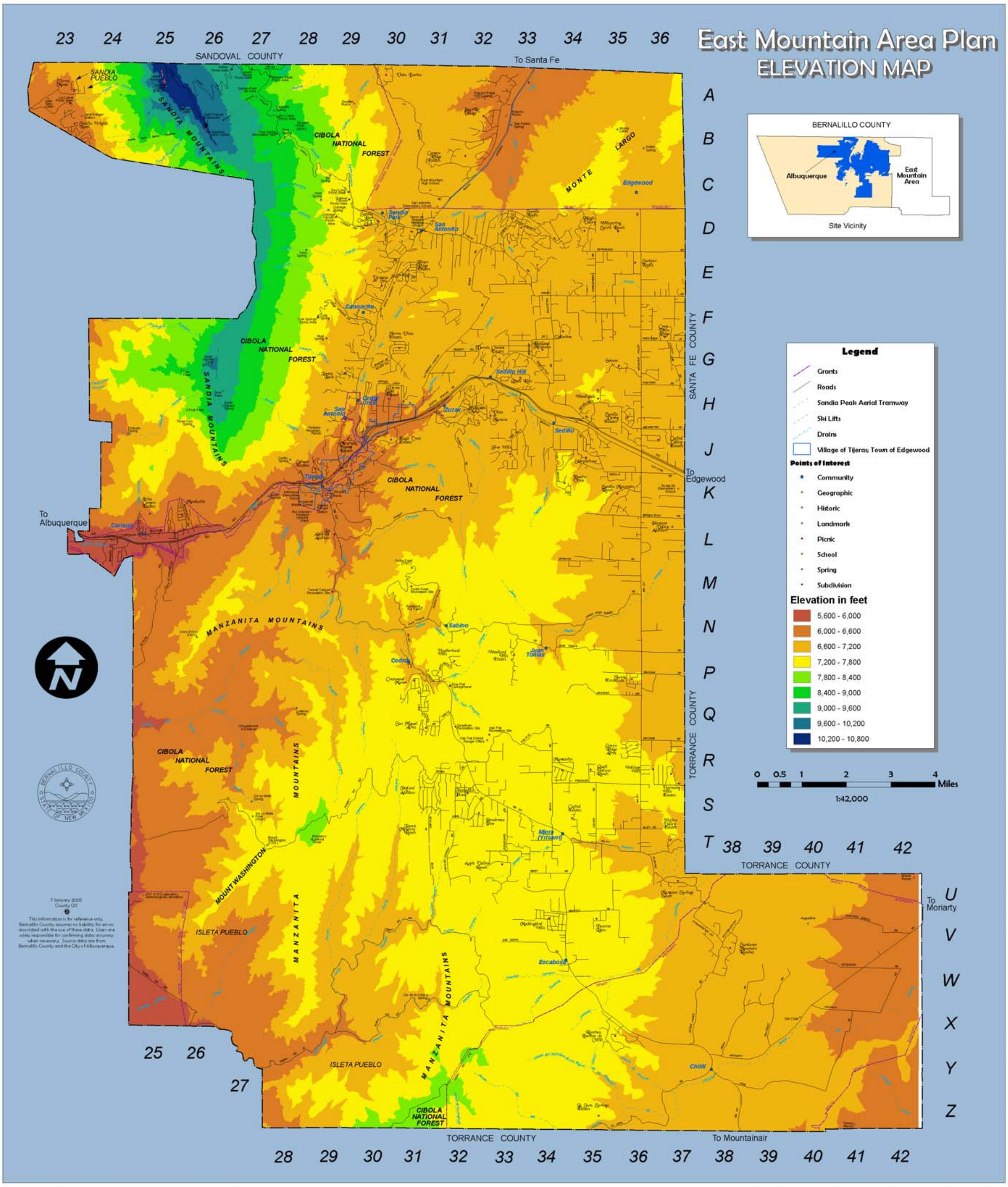
Table 5 below compares the precipitation data gathered over the last 3 years by the United States Geological Survey (USGS) and volunteer precipitation station monitors to historical averages gathered over a longer period. With the exception of the first set of data, comparing the Sandia Crest gauging station (in operation from 1953-1979; elevation of 10,686 feet) to USGS Site 1 (Fig. 1) that is to the east (elevation of 10,030 feet). As the table shows, the 2001 through 2003 were lower than the average for the period of records at all three stations, indicating that the decrease in precipitation recorded at the USGS Site 1 is not simply related to the gauge being at a lower elevation than the Sandia Crest gauge, but is also related to the drought during this period of record.

Table 5

Comparison of average annual precipitation at NOAA precipitation stations
with monthly and annual precipitation at USGS and volunteer A37 precipitation sites.

Site	**Annual Precipitation** inches	**Percent of average Annual**
Sandia Crest elevation 10,686 feet amsl (Site 8, fig. 1) 1953-79 average compared to USGS Site 1 elevation 10,030 feet amsl, fig. 1, 2001-03.		
Sandia Crest average (1953-79)	*19.13*	
USGS Site 1, 2001	12.71*	66
USGS Site 1, 2002	12.21	53
USGS Site 1, 2003	7.85*	34
Sandia Park elevation 7,009 feet amsl (Site 9, fig. 1) 1939-2001 average compared to USGS Site 3 elevation 7,030 feet amsl, fig. 1, 2001-03.		
Sandia Park average (1939-2001)	*19.06*	
USGS Site 3, 2001	13.75*	72
USGS Site 3, 2002	9.73	51
USGS Site 3, 2003	15.52	81
Sandia Ranger Station elevation 6,306 feet amsl (Site 10, fig. 1) 1933-74 average compared to USGS Site 7 elevation 6,350 feet amsl, fig. 1, 2001-03.		
Sandia Ranger Station average (1933-74)	*13.29*	
USGS Site 7, 2001	12.47*	94
USGS Site 7, 2002	11.28	75
USGS Site 7, 2003	10.50	70

* some data missing during year.



To approximate the amount of precipitation that falls, on average, in the East Mountain Area, a linear relationship between elevation and average annual precipitation was developed, based on available precipitation data that have been collected at several different weather stations in the area (Figure 3). Based on the average annual precipitation, roughly 272,600 ac-ft/yr falls in the East Mountain Area. Table 6 outlines the average annual precipitation that falls in each of the watersheds described above.

The estimated precipitation is an approximation, at best, for several reasons. One, not all of the weather stations have the same periods of record, so the average precipitation data used are not ideal. Two, it appears that there may be more of a relationship between elevation and precipitation during the winter months, and less of one during the summer months, perhaps because during the summer monsoon season, storms tend to be more localized and intense. Three, there can be considerable variability in annual precipitation as shown in Figure 2. Nevertheless, an annual average precipitation relationship was developed to provide an estimate of precipitation in the region, which may be useful for planning purposes, particularly as it provides us with a guide for estimating recharge.

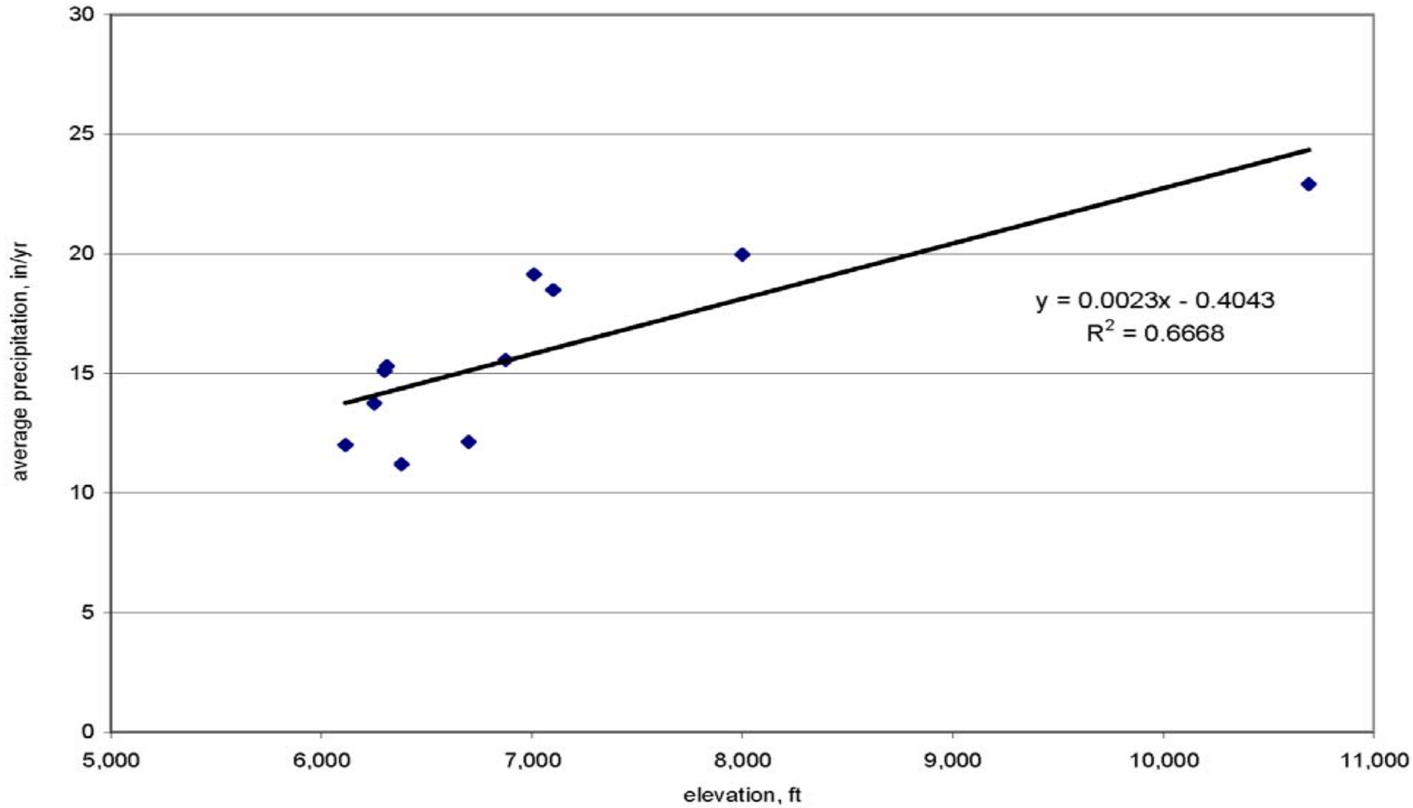


Figure 3. Linear relationship between elevation and precipitation based on average annual precipitation recorded at weather stations in the vicinity of the East Mountain Area, Bernalillo County, New Mexico.

JOHN SHOMAKER & ASSOCIATES, INC.
WATER RESOURCE AND ENVIRONMENTAL CONSULTANTS

Table 6

Approximation of average annual precipitation in East Mountain Area watersheds.

Watershed	Average Annual Precipitation, ac-ft/yr
West-facing slopes of Sandia Mountains	14,200
West facing slopes of Manzanos and Manzanitas	60,700
Estancia Basin in East Mountain Area	88,800
Tijeras Canyon	64,200
San Pedro Creek	44,700

Recharge

In the 1992 East Mountain Area Plan (based on a 1991 study by Molzen-Corbin & Associates and Lee Wilson & Associates) recharge rates were considered to range from 0.1 to 1.0 inches per year, with a general rate of 0.5 in/yr. Finch et al. (1995) estimated that recharge at the San Pedro Mine in Santa Fe County ranged from 1.0 to 5.3 in/yr based on watershed modeling. That study cited other recharge studies including Summers (1981) who estimated recharge in the vicinity of the Ortiz Mountains was 1.06 in/yr. and Wasiolek (1991) where 15% of precipitation in the Sangre de Cristo Mountains was estimated to be recharged.

Recharge is a difficult quantity to measure, particularly in the semi-arid and arid environments of the southwestern United States. Because of the considerable variability in soils, vegetation, precipitation, geology and more, it is difficult not only to try to measure recharge at one location, but also to take that site-specific estimate and extrapolate it to a region. Often, scientists assessing recharge will base their estimates on how much groundwater discharged from the subsurface to areas like lakes, streams, or playas, because total outflow and consumption is the same as total inflow (recharge) in a steady-state system. Some scientists have used that technique and then developed coefficients that when multiplied with the area of the precipitation zones in a region, yield recharge estimates. In more rigorous studies, scientists will estimate recharge using techniques such as those mentioned above (or others) and then test and refine their estimates using a groundwater-flow model.

Because of the complex groundwater-flow system in the East Mountain Area, a thorough and detailed recharge estimation is not possible within the scope of this plan. However, it is possible to roughly approximate what the recharge may be by using approaches or data developed from previous studies. Two methods were evaluated for this plan. A cursory approximation of recharge was based on precipitation using "Maxey-Eakin" coefficients developed in for Nevada (Maxey and Eakin, 1949). The areal precipitation estimate described in the above-referenced section was delineated into Maxey-Eakin precipitation zones, and an average recharge was estimated for each zone based on the coefficients listed in Appendix D Table 1. Based on this approach, about 37,200 ac-ft/yr was roughly estimated to represent possible average recharge for the entire East Mountain Area, or about 14 percent of the average annual precipitation estimated to fall within the East Mountain area .

Part of the East Mountain Area of Bernalillo County lies within the Estancia Basin. A groundwater-flow model of the Estancia Basin that the Office of the State Engineer uses to administer water rights in that area (Shafike and Flanigan, 1999; Keyes and Frost, 2001) assigns recharge quantities for the area. The OSE-assigned recharge quantity was compared with the values that the Maxey-Eakin approach produces. The recharge used in the Estancia Basin (a closed basin) was initially quantified based on estimated groundwater discharge, and the groundwater-flow model reasonably reproduced observed water levels in the area. In the Estancia Basin model, there were three zones of recharge, about 3.0 in./yr in upper elevations, 0.4 in./yr in middle elevations, and 0.03 in./yr in lower elevations (the lowest recharge value was not located in the East Mountain Area of the Estancia Basin). For the Estancia Basin portion within the East Mountain area, the Estancia Basin model estimates 8,650 ac-ft/yr, and the Maxey-Eakin approach estimates 12,320 ac-ft/yr. The Estancia Basin recharge estimate is less than the Maxey-Eakin approach, and may be more accurate because of the more rigorous approach involved in its estimation via the development of the groundwater flow model and having an initial estimate of groundwater discharge from the Estancia Basin. The estimates provided in Table 7, however, are more conservative than those provided by either the Maxey-Eakin method or the method developed for the Estancia Basin model. This is because the method used in the Estancia Basin model assumes a recharge rate of 3 inches per year for all elevations above about 7,000 feet. The method used to develop the estimates in Table 7 is based on the fact that precipitation increases with increasing elevation. The estimates assume that annual average recharge varies with elevation in the following manner: 0.4 inches per year for elevations ranging from 5,000 to 7,000 feet; 1.05 inches from 7,000 to 8,000 feet; 1.7 inches from 8,000 to 9,000 feet; 2.35 inches from 9,000 to 10,000 feet; and 3 inches above 10,000 feet.

Annual recharge likely varies in a manner similar to seasonal and annual precipitation fluctuations. Because annual precipitation is variable, it follows that annual recharge fluctuates as well. For planning purposes, it is important to consider what the lower recharge rates and amounts might be. To do this, precipitation data from USGS weather stations in the East Mountain Area monitored in 2002 (a low precipitation year) were consulted to consider what a "low" recharge rate might be. During that year, precipitation at Sandia Park was 9.73 inches. Based on the Maxey-Eakin method (which likely overestimates recharge) in a year with 10 inches of precipitation, the recharge rate might be 0.3 in/yr and in some places that receive less than 8 inches per year of rain, there may be little to no appreciable recharge.

Table 7.

Estimated annual recharge for the East Mountain Area watersheds based on the Estancia Basin groundwater flow model recharge rates.

Watershed	Estimated average recharge, ac-ft/yr
west-facing slopes of Sandias	1,027
west facing slopes of Manzanos and Manzanitas	2,861
Estancia Basin in East Mountain Area	4,387
Tijeras Canyon	3,037
San Pedro Creek	2,364

The rate at which water recharges groundwater is another important consideration. In the early 1990s during intensive monthly monitoring, the USGS observed a rise in groundwater levels following unusually large amount of precipitation during an individual storm event. Their data suggest water may recharge the groundwater system in certain areas in as little as a month or so after a significant precipitation event (Blancard and Kues, 1999). Other anecdotal evidence based on precipitation fluctuations and groundwater levels in a well suggested that groundwater levels in some areas may respond to increased precipitation amounts in about 2 1/2 years (Kues, 1990). The USGS recently completed a study that attempted to date groundwater from wells by sampling for chlorofluorocarbons (Blanchard, 2004). While there are many caveats associated with this type of dating, the USGS concluded that apparent ages of groundwater in their samples ranged from as young as 10 to 16 years and as old as 20 to 26 years. The results were interpreted to suggest that "recharge occurs rapidly through fractured and solution channeled limestone and that recently recharged groundwater mixes with older water in the groundwater system along flow paths upgradient from the sampled wells." (p. 17, Blanchard, 2004).

Groundwater

Groundwater is defined as 1) water within the earth that supplies wells and springs; 2) water in the zone of saturation where all openings in rocks and soil are filled, the upper surface of which forms the water table (Webster's Third new International Dictionary, 1993). Understanding the geologic units in which groundwater is stored and through which groundwater flows is another important component of water planning. The East Mountain Area geology primarily consists of consolidated rock such as limestone, sandstone, and some shale, often stacked on top of one another, and in many areas, the geology is quite complex due to faulting, fracturing and folding of the rocks.

An aquifer consists of those strata in which voids and openings are filled with water and through which economically useable quantities and quality of water can be transmitted. Hydrogeologists assess the productivity of aquifers by performing aquifer tests and estimating properties based on the results of those tests. Hydraulic conductivity and transmissivity (also referred to generally as permeability, while transmissivity is the permeability multiplied by the thickness of the aquifer) are two of those types of properties. They provide information as to how easily an aquifer can transmit water through its pore spaces and fractures. Specific yield is a property that can be measured from aquifer tests that indicates how much groundwater can be drained from the aquifer under water-table (unconfined) conditions. Water can also be present in aquifers in what is referred to as confined conditions. Confined aquifers are often referred to as artesian aquifers, but it should be noted that the water pressure in these types of aquifers must simply be sufficient to rise the water table above the top of the aquifer, not necessarily flow at the ground surface. Specific storage is the termed used to define the quantity of water released from storage for a corresponding decline in water level (hydraulic head). Values for specific storage are generally much smaller than specific yield values. The higher the hydraulic conductivity value, the more easily water is transmitted, and the higher the specific yield the more groundwater there is in unconfined storage.

Another measurement that hydrogeologists consider is well yield. Well yields are sometimes reported as estimates on well driller logs and they represent the rate of groundwater production from a well generally reported as gallons per minute. It can be a useful measurement to consider, but well yields are a function of not only the aquifer, but the way in which the well was drilled and completed, the depth of the well, and the capacity of the pump in a well. It is also important to consider how much the water level decreases in a well for each gallon per minute of water produced, or the specific capacity of the well, and not just the total well yield. Appendix D Figure 1 shows the distribution of yields by township based on well yield data reported in the New Mexico Office of the State Engineer (NMOSE) WATERS database. Neither the NMOSE nor the County track dry wells, thus it is difficult to estimate how many dry wells exist.

Bernalillo County currently supports and participates in groundwater investigations in the East Mountain area and is also undertaking a major effort to gather all existing information into a geographic information system (GIS) that will assist in describing groundwater resources in various parts of the East Mountains. The usefulness of this information will depend upon frequent updates with any new data that is obtained from the United States Geological Survey (USGS), NMOSE, or other sources.

The following discussion describes the geology of the East Mountain Area, selected aquifer properties, reported well yields for selected regions, groundwater flow directions, and groundwater storage.

<u>Aquifers</u>

The East Mountain Area of Bernalillo County has many different geologic units exposed at the surface representing the Precambrian, Pennsylvanian, Permian, Triassic, Jurassic, Cretaceous, and Quaternary ages of geologic time (ordered from oldest to youngest) (Figure 4) . The East Mountain Area is located on the edge of two major basins, the Middle Rio Grande Basin to the west and the Estancia

Basin to the east. The mountain ranges of the Sandias, Manzanos, and Manzanitas generally define the western edge of the East Mountain Area. Faulting has uplifted those ranges, and eroded them such that the west facing slopes are generally steeper than the east facing slopes. Precambrian-age crystalline rocks underlie sedimentary rocks that tilt toward the east, more steeply off the Sandia Mountains (15-20 degrees) and less so off the Manzanitas and Manzanos (3-4 degrees) (Titus, 1980). In the north central part of the area a major fault system, oriented northeast-southwest, juxtaposes older rocks against younger rocks. The Tijeras and Guiterrez faults running through the central portion of the east mountain area are two of the major southwest-northeast trending structures associated with this system (Fig. 4). The geologic units in the vicinity of the faults have also been folded, and thus, in this region, the geology is quite complex. Appendix Figures 2, 3, and 4 are geologic cross-sections (vertical slices through the subsurface viewed from the side) showing how geologic units may be tilted and faulted in various places in these selected areas of the subsurface.

Generally, the west-facing slopes of the Sandia, Manzano, and Manzanita Mountains, the lower part of Tijeras Canyon, and Monte Largo, are composed of Precambrian-age crystalline rocks. The north central region of the East Mountain Area contains Permian- and Triassic-age clastic and carbonate rocks and Jurassic- and Cretaceous-age clastic rocks. In the remaining areas, which represent most of the planning region, the Pennsylvanian-age Madera Group, and the underlying Sandia Formation are exposed at the surface or are close to the surface. The following sections describe these geologic units in more detail based on Titus (1980) unless otherwise noted. They are described in terms of geologic 'groups,' 'formations,' and 'members' (A geologic 'group' represents a collection of similar geologic formations, and a geologic 'formation' may contain a series of several similar geologic 'members'). The units are described from oldest to youngest in geologic age.

The locations of Precambrian-age crystalline rocks in the study area are shown on Figure 4. For the most part, these rocks are exposed on the steep slopes in the western side of the study area, in Tijeras Canyon, or in the north part of the study area bounded by two major north-east trending faults, the Tijeras and the Gutierrez. Faults and the fracturing they can create, in addition to fractures which can result from other geologic processes such as folding, present in these rocks locally create permeable zones, which provide small amounts of reasonable quality groundwater to wells. Kues (1990) reported that selected wells in fractured crystalline rocks averaged 15 gallons per minute (gpm) and ranged from 2 to 37.5 gpm based on 13 wells. Areas that are not fractured are not likely to yield much water to wells, and in some areas, wells may be dry. Appendix D Table 2 shows aquifer property data available for crystalline rocks in the East Mountain Area.

Pennsylvania-age Sandia Formation and Madera Group are located stratigraphically above the Precambrian-age units; their location is shown on Figure 4. The Sandia Formation is composed of black shale, dark-gray limestone, and gray-olive and brown sandstone about 10 to 230 ft in thickness (Kelley, 1963; Reiche, 1949). Based on spring discharge, Titus (1980) speculated that the Sandia Formation limestone might have a high permeability from fractures and cavernous zones, and the sandstone beds in the unit, a moderate permeability. Based on wells completed in the western San Pedro Creek area, well yields in the Sandia Formation may be as high as several tens of gallons per minute.

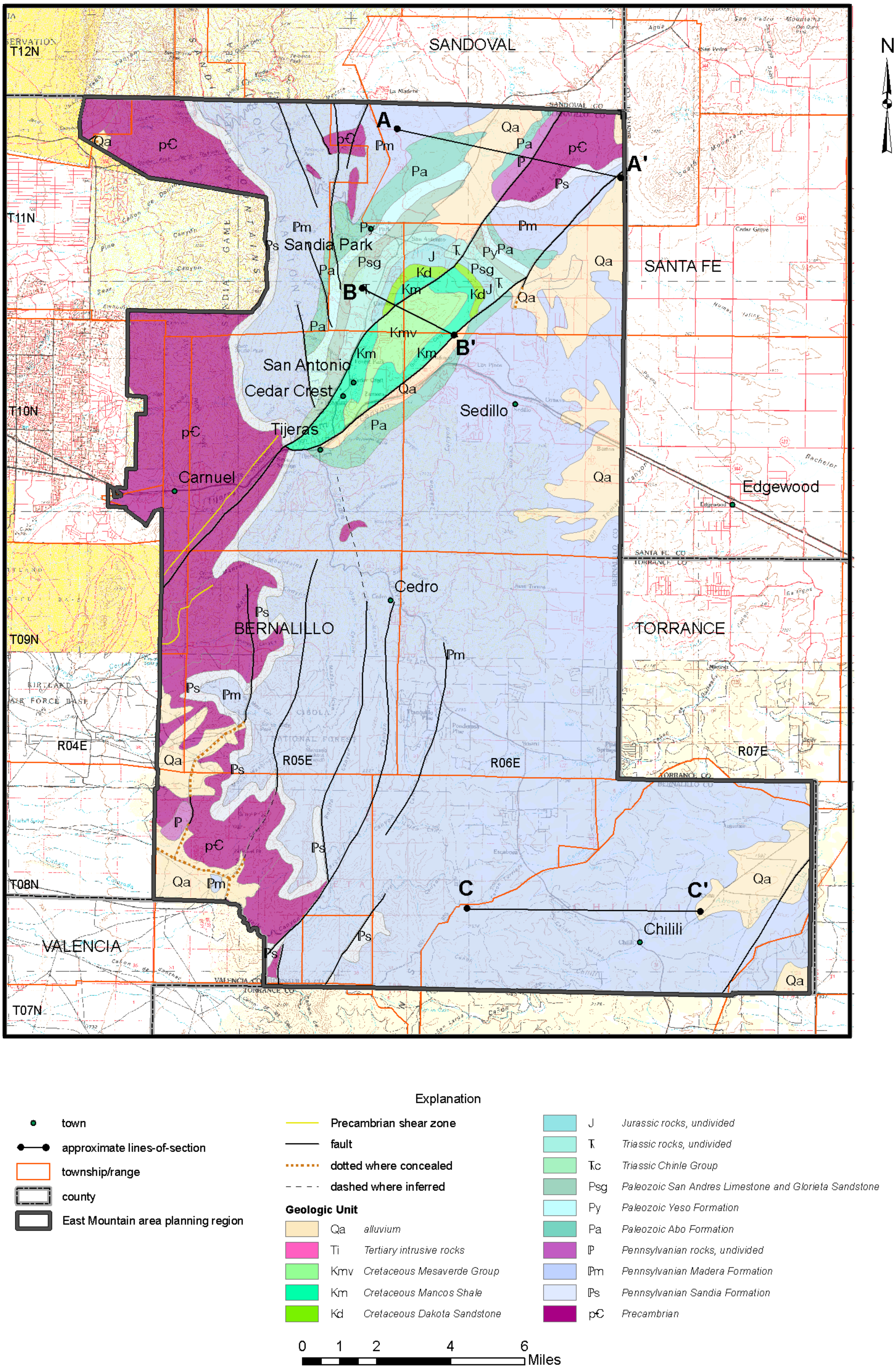
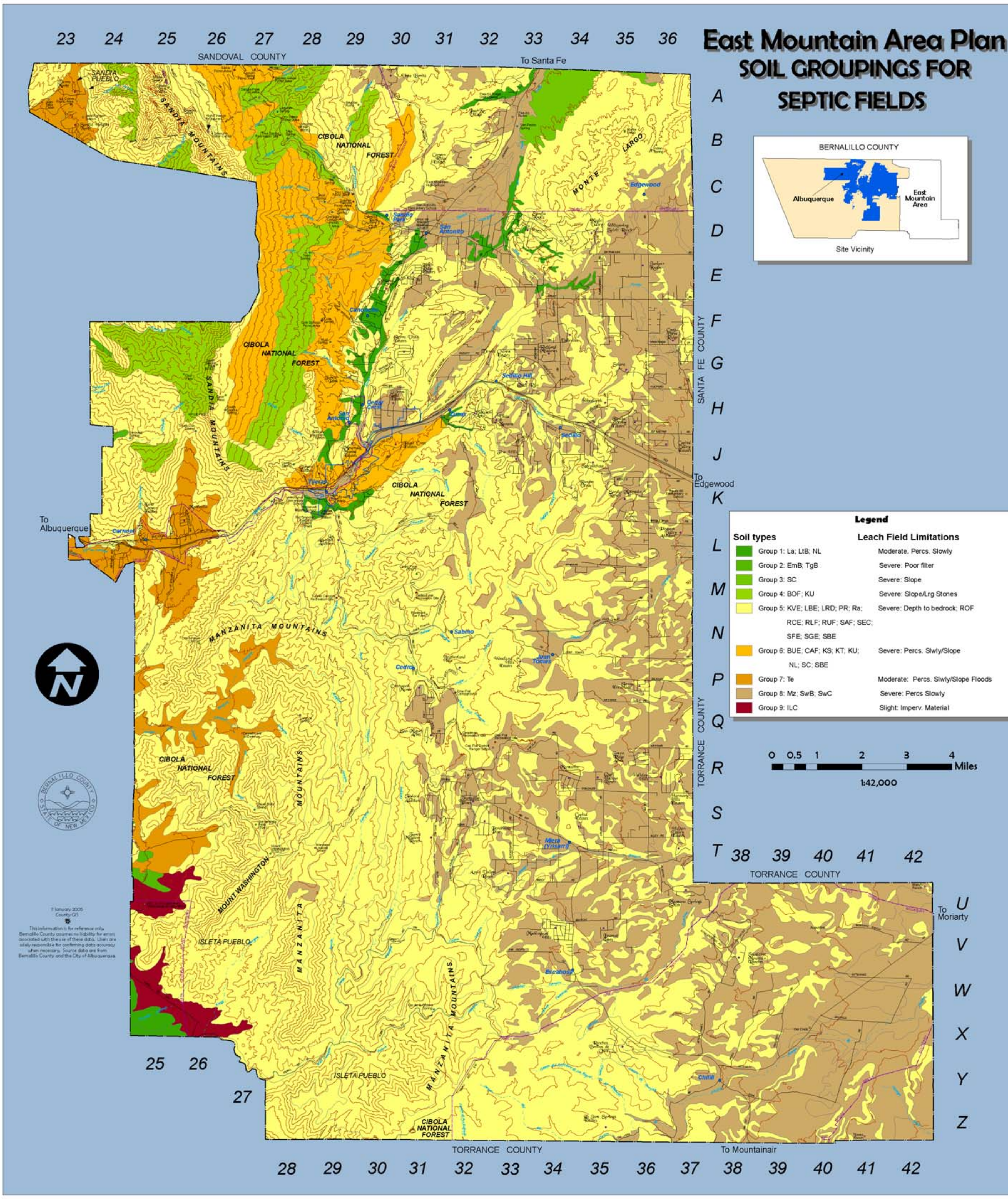


Figure 4. Map showing the regional geology of the East Mountain Area, Bernalillo County, New Mexico

JOHN SHOMAKER & ASSOCIATES, INC.


East Mountain Area Plan
SOIL GROUPINGS FOR SEPTIC FIELDS
BERNALILLO COUNTY
Albuquerque
East Mountain Area
Site Vicinity
Legend
Soil types
Leach Field Limitations
Group 1: La; LtB; NL — Moderate. Percs. Slowly
Group 2: EmB; TgB — Severe: Poor filter
Group 3: SC — Severe: Slope
Group 4: BOF; KU — Severe: Slope/Lrg Stones
Group 5: KVE; LBE; LRD; PR; Ra; RCE; RLF; RUF; SAF; SEC; SFE; SGE; SBE — Severe: Depth to bedrock; ROF
Group 6: BUE; CAF; KS; KT; KU; NL; SC; SBE — Severe: Percs. Slwly/Slope
Group 7: Te — Moderate: Percs. Slwly/Slope Floods
Group 8: Mz; SwB; SwC — Severe: Percs Slowly
Group 9: ILC — Slight: Imperv. Material
0 0.5 1 2 3 4 Miles
1:42,000
SANDOVAL COUNTY
To Santa Fe
SANTA FE COUNTY
TORRANCE COUNTY
To Albuquerque
To Edgewood
To Moriarty
To Mountainair
CIBOLA NATIONAL FOREST
SANDIA MOUNTAINS
MANZANITA MOUNTAINS
MONTE LARGO
MOUNT WASHINGTON
ISLETA PUEBLO
SANTA ANA PUEBLO

The Madera Group is typically divided into a lower member and an upper member. The lower member is composed of gray limestone with shale and siltstone beds and in outcrop; its thickness is 430 to 700 ft. The upper member is 800 to 900 ft thick in outcrop and is light gray limestone with more than half interbedded, red to brown sandstone, siltstone and gray shale. The thickness of the Madera Group increases in the subsurface to the east. The Madera Group is the main aquifer in the southern half of the East Mountain Area, and is also an important aquifer in portions of the northern East Mountain Area. Although it is the primary aquifer in places, it does not consistently produce adequate supplies of water. Titus noted that about one in five wells drilled into the Madera Group was a dry hole. The productivity and permeability of the Madera Group is variable and likely depends on solution-enhanced fractures and bedding planes in limestone beds. Kues (1990) reported the well yields from selected regions in the East Mountain Area. Well yields in most of the area for fractured limestone range from 1 to 49 gpm with an average of 9 gpm based on 26 wells; sandstones yields ranged from 1 to 12 gpm, with an average of 6 gpm based on 6 wells. Well logs for wells completed in the Madera but lacking specific rock unit identifications suggest well yields ranging from 1.5 to 37 gpm, with an average of 12 gpm based on 18 wells. Well yields from shale in the Madera in the Barton area ranged from 0.5 to 10 gpm, with an average of 5 gpm. Appendix D Table 2 shows aquifer property data available for the Madera Group in the East Mountain Area.

The Permian-age Abo Formation is described as a dark red, or reddish brown shale, with local sandstone beds that can be tens of feet thick, with the total thickness of the unit from 700 to 900 ft. Titus reports that in the Sandia Mountain area, the Abo Formation is sufficiently permeable to provide adequate quantities of water to wells. Kues (1990) estimated from 3 wells that well yields in the Abo Formation average 18 gpm and range from 15 to 20 gpm. Appendix D Table 2 shows aquifer property data available for the Abo Formation in the East Mountain Area.

The Permian-age Yeso Formation is a composed of a lower tan-brown to buff sandstone about 90 to 150 ft thick (Meseta Blanca Member), and an upper orange-red and pink sandstone interbedded with shale, cavernous limestone and some gypsum and gypsiferous siltstone, about 250 to 400 ft thick (San Ysidro Member). Titus (1980) reported that adequate groundwater was produced from the lower and upper units in the Yeso Formation. Appendix D Table 2 shows aquifer property data available for the Yeso Formation in the East Mountain Area. Total dissolved solid concentrations may be high in the Yeso Formation.

The Permian-age San Andres Limestone and Glorieta Sandstone typically act as one aquifer, and thus they are grouped as such and shown on Figure 9. The Glorieta Sandstone, the lower of the two, is a yellowish-gray to white, sandstone, up to 150 ft thick, and up to 190 ft thick, the San Andres is a gray limestone, with locally occurring solution channels, and also includes a buff to tan, medium-grained sandstone. Kues (1990) reported that yield of 2 wells from the San Andres Limestone were 3 and 40 gpm. Appendix D Table 2 shows aquifer property data available for the San Andres-Glorieta aquifer in the East Mountain Area. A well in the northern part of the East Mountain Area reported a well yield of more than 1,000 gpm from the San Andres and Glorieta aquifer.

The outcrop area of Triassic-age Santa Rosa Sandstone and Chinle Formation is shown on Figure 4. The Santa Rosa Sandstone is light gray to reddish brown with some shale and is about 70 to 400 ft thick. Well yields are reported to be sufficient for domestic use. Based on 9 wells, Kues (1990) reported well yields from the Santa Rosa Sandstone ranged from 2 to 25 gpm, with an average of 15 gpm. Appendix D Table 2 shows aquifer property data available for the Santa Rosa Sandstone in the East Mountain Area.

The Chinle Formation is a reddish brown to tannish brown mudstone with some discontinuous sandstone units and its thickness ranges from 1,300 to 2,000 ft. The permeability of the Chinle Formation is limited to its sandstone beds and fractured areas. Wells in Titus' 1980 study indicated adequate yields. Kues (1990) reported that well yields range from 10 to 23 gpm with an average of 15 gpm based on 5 wells. Appendix D Table 2 shows aquifer property data available for the Chinle Formation in the East Mountain Area.

The Jurassic-age Entrada Sandstone, Todilto Limestone and Morrison Formation outcrop areas are shown on Figure 4. The Entrada Sandstone is 100 to 145 ft thick, and is described as buff to tannish-brown, or greenish-yellow. The Todilto Limestone is composed of limestone (sometimes foul smelling which affects the odor of the water) ranging from less than a foot to 85 ft, and gypsum (with some limestone) ranging from 25 to 230 ft thick. The Morrison Formation is composed of mudstone, sandstone, conglomerate, and some limestone from 480 to 750 ft thick. Because these units either have or are next to gypsum deposits in the Todilto, sulfate concentrations, and overall total dissolved solids, may be high. Kues (1990) reported that well yields for three wells in the Morrison range from 4 to 80 gpm. Appendix D Table 2 shows aquifer property data available for the Morrison Formation in the East Mountain Area.

The Cretaceous-age Dakota Sandstone is a light gray to buff sandstone with some black shale and it is about 5 to 250 ft thick. In areas where the sandstone has been fractured, the unit may be more permeable. It may comprise a single aquifer with the underlying Morrison Formation.

The Cretaceous-age Mancos Shale overlies the Dakota Sandstone and is predominantly a black shale with some interbedded light gray and yellowish gray sandstone and siltstone. It is about 1500 to 1800 ft thick. The Mancos Shale is not a good aquifer in the area; some wells that have been drilled into the unit have been dry and additionally the water quality is usually characterized by high total dissolved solid concentrations. There have been reports of reasonable quality water from the Mancos Shale, and Titus (1980) suspects that fresher water from the overlying alluvium, or other aquifers via faults, may be mixing with water in the Mancos. Kues (1990) reported that based on data of 4 wells, well yields ranged from 0.5 to 6 gpm, with an average of 4 gpm. Appendix D Table 2 shows aquifer property data available for the Mancos Shale.

The Cretaceous-age Mesaverde Group is composed of gray to tan sandstone, dark-brown to black shale, and coal lenses up to 4 ft thick. It is exposed in a 4 square mile area, and thickness ranges from a few hundred feet to 1,500 ft thick. Titus (1980) reports that well yields in the Mesaverde range from less than 1 gpm to 35 gpm and that the water quality is usually poor due to high total dissolved solids and sulfate concentrations. Kues (1990) reported that of 3 wells, well yields ranged from 0.5 to 10 gpm. Appendix D Table 2 shows aquifer property data available for the Mesaverde Group.

Quaternary-age alluvium represents the most recent geologic deposits in the East Mountain Area. It is found along drainages and thicknesses and can be as much as 65 ft thick in portions of Arroyo San Antonio, 90 ft in Frost Arroyo, and 100 ft or more in Tijeras Canyon. In areas where alluvium is sufficiently thick, saturated groundwater may be present at the bottom of the deposit, where it is underlain by less permeable geologic units, but in many areas, particularly in the southern East Mountain Area, the alluvial deposits may be above the water table. Titus (1980) reports the maximum potential yield is likely 50 gpm, but because of fluctuations in precipitation and groundwater levels, yields may vary seasonally and become very low during periods of drought. The alluvial groundwater quality is somewhat reflective of groundwater discharging from bedrock aquifers, but usually total dissolved solids concentrations are less than 500 mg/L.

To determine which aquifer might be suitable for a desired area, more detailed site specific studies are recommended. As noted earlier, many of the units may be folded or faulted, making the geology complicated in the subsurface. The units shown at the surface may not be present as aquifers directly under a site at a given depth; conversely, units that do not outcrop directly under a site might be present at depth. Variability of aquifer properties within a geologic unit is highly likely. Detailed site specific hydrogeologic studies are critical in planning additional groundwater development.

Groundwater Flow

Titus (1980) prepared a groundwater level elevation contour map and estimated groundwater flow directions based on data from the 1960s. For this plan, an updated water-level elevation contour map was prepared for the East Mountain Area based wells measured by the USGS between 1995 and present (Figure 6). Groundwater in the East-Mountain area generally moves to three areas: Tijeras Canyon, the Estancia Basin, or San Pedro Creek. Appendix D Figure 5 shows how ground-water levels have fluctuated and, in many places, declined in selected wells that have been monitored by the USGS. Depth to water can be quite variable in the East Mountain Area and can be tens of feet below the surface in arroyos and valleys, to several hundred feet below the surface in areas higher in elevation.

Groundwater Storage

Estimating groundwater storage in the East Mountain Area is challenging because the geology is complex. Estimates of total groundwater in storage, (i.e. the amount of water stored in the aquifers voids and released due to decreasing water levels) provides a somewhat misleading number because in order to extract all the water from an aquifer, a great number of closely spaced wells drilled throughout the entire thickness of the saturated rocks would be needed. For the purposes of the plan, groundwater storage is

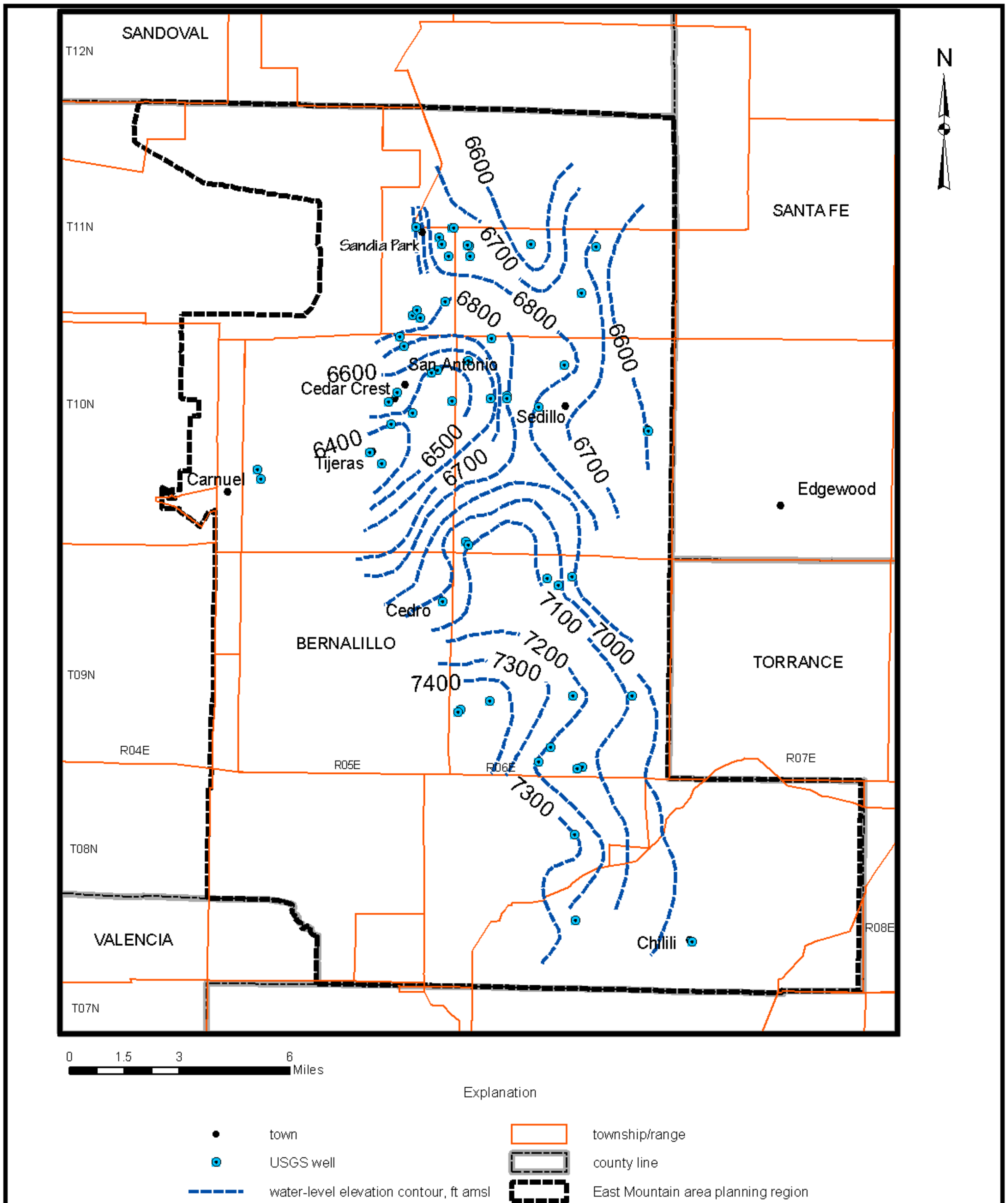


Figure 6. Map showing estimated regional groundwater levels in the East Mountain Area based on USGS water –level data collected from East Mountain Area aquifers between 1995 and present. Where data were absent, water levels were not contoured.

JOHN SHOMAKER & ASSOCIATES, INC.

estimated in terms of how much water can be released from storage associated with a 100 foot decline in regional water levels. This aquifer thickness was selected because aquifer thicknesses are highly variable with many rock units being absent throughout most of the planning area. Site specific aquifer thickness values can be multiplied by the estimated groundwater in storage values per 100 foot of aquifer to estimate total groundwater in storage for specific locations. To make the simplified estimates of groundwater in storage, the geologic units in the East Mountain Area were divided into two areas based on the potential aquifers present, (1) the Sandia Formation and Madera Group, and (2) the remaining sedimentary rocks in the study area (Groundwater storage was not estimated for Precambrian-age rocks). Because storage is being estimated in the shallowest part of the aquifer, and because in places, rocks are fractured and faulted, it was assumed that groundwater was unconfined. Some wells do produce from confined storage in the East Mountain Area, and those storage coefficients (representing confined conditions) are less than specific yield (representing unconfined conditions) estimates, but as the confined storage is pumped off, the storage becomes unconfined. Specific yield values were based on values used in the Estancia Basin groundwater model (Shafike and Flanigan, 1999). In the model, the Madera Group specific yield ranged from 0.005 to 0.03. For the remaining sedimentary rocks, the Abo/Yeso specific yield ranged from 0.01 to 0.03, the Glorieta/San Andres specific yield ranged from 0.05 to 0.10 and Triassic, Jurassic, and Cretaceous-age units ranged from 0.01 to 0.05. The lower specific yield values were selected. The resulting rough estimates of groundwater storage per 100 ft of regional drawdown are shown in Table 8.

Table 8.

Estimated groundwater in storage per 100 ft of regional drawdown.

Aquifer	Specific yield[a]	Area, acres	Regional drawdown, ft	Storage, ac-ft/100 ft of aquifer
Sandia Formation and Madera Group	0.01	134,400	100	134,400
Permian-, Triassic-, Jurassic-, and Cretaceous-age sedimentary rocks	0.02	19,100	100	38,200
Precambrian-age rocks[1]		Not estimated		

[1] San Andres-Glorieta aquifer may have higher storage

Water quality and contamination

Most aquifers in the East Mountain Area are vulnerable to groundwater contamination. In particular, limestone aquifers have numerous faults, cracks, or dissolution features where water is stored and transmitted. If these features are near the surface and in proximity to a septic system drain field or other contaminant source, there is a potential for contaminates, such as waste-water related nitrate, to enter the groundwater. Scattered groundwater contamination in the East Mountain Area consists of nitrate contamination associated with septic tanks and drain fields, and some petroleum products contamination associated with leaking underground storage tanks (LUST's). The New Mexico Environment Department developed new construction standards for Underground petroleum storage tanks in the early 1990's, and better construction standards (double-walled tanks, monitoring, etc.) have helped reduce the opportunity for leaks from these types of systems to occur.

Because of the susceptibility of the East Mountain Area aquifers to contamination, industrial and commercial development having the potential to contaminate groundwater should be carefully monitored and regulated. Additionally, the New Mexico Environmental Department has produced updated waste water regulations, based on U.S. Environmental Protection Agency standards, which will be adhered to by Bernalillo County and will lead to increased protection against pollution. Inefficient septic systems can be upgraded to achieve better performance, particularly with the newer technologies now available. The County should seek sources of financial assistance and resources to remedy these problems.

Bernalillo County has enlisted the help of other agencies, like the USGS, to better understand trends and distribution of contamination. One approach to evaluating contamination from on-site waste water disposal is to monitor concentrations of nitrate. Figure 11 shows a map with selected graphs that illustrate trends in nitrate contamination in certain areas. There is variability between and within areas – some areas have nitrate contamination issues such that the water exceeds the maximum contaminant level for nitrate (as N) of 10 mg/L. Recent work by Thomson et al. (2000) and McQuillan (2004) suggest that other parameters should be monitored, in addition to nitrate, to identify septic system. In some areas, nitrogen compounds in effluent are converted to nitrate because of the absence of oxygen in the subsurface. In these situations though, other contaminants such as synthetic organic compounds, or bacteria, might be present.

Appendix D Figure 6 also shows the concentration of fluoride in groundwater at selected locations monitored by the USGS. Water quality samples from the East Mountain Area indicate that fluoride concentrations in groundwater are below the New Mexico Environment Department, Drinking Water Bureau standard of 4.0 mg/L. The highest fluoride concentrations reported by the USGS are 1.9 and 1.5 mg/L for two wells in the Carnuel area, and 1.3 mg/L for a well near Ponderosa. All other reported fluoride concentrations were below 1.0 mg/L.

The impact of future land-use planning on water availability, quantity, and quality within the East Mountain Area is a critical issue to be addressed in the plan. The issues of water and waste water were ranked ninth on the list of important priorities in the 2003 community survey. The interrelationship of precipitation, groundwater, consumptive use, waste water treatment, and other environmental factors must be recognized and translated into consistent land use recommendations that address the vulnerability of the entire natural and social environment, including water supply, in the East Mountain Area.

Water Resources and Lot Size in the East Mountain Area

The East Mountain Area Water System Feasibility Study, prepared by Molzen-Corbin & Associates and Lee Wilson & Associates, Inc. in 1990, attempted to determine a range of self-sustaining lot size requirements that would balance consumptive use per household with recharge. Their approach was to prepare a matrix showing what the sustained lot size would be for various recharge rates ranging from 0.1 to 1.0 inches per year and for various per household water demands. Based on their matrix, lot size ranged from as little as 1.5 acres (assuming a per household demand of 160 gpd and a recharge rate of 1.0 in/yr) to 30 acres (assuming a per household demand of 320 gpd and a recharge rate of 0.1 in/yr). Based on that study, the estimated generalized recharge rate for the East Mountain Area was 0.5 in/yr, the consumptive use was about 100 gallons per person per day and based on those estimates, a lot size of 2 acres exceeded the carrying capacity of the regional groundwater supply (East Mountain Area Plan, 1992).

Although an average recharge rate of 0.5 in/yr is reasonable, recharge rates vary with precipitation from year to year. In some years recharge might be lower. Because recharge is estimated to move relatively quickly through most aquifers in the East Mountain Area, water levels are also likely to respond quickly to fluctuations in precipitation. In some places recharge might be less than average estimated values, particularly in areas where the local permeability of the aquifer is low because of few fractures, or cracks, in the rock.

In the earlier recharge section, based on the Maxey-Eakin method (which likely overestimates recharge) in a year with 10 inches of precipitation, the recharge rate might be as low as 0.3 in/yr, and in some places that receive less than 8 inches per year of rain, there may be little to no appreciable recharge. During droughts, there may be little to no recharge, and groundwater levels may decline. Declines in groundwater levels can also be affected by interference from groundwater pumping wells. In addition to considering recharge rates in evaluation of lot size, the amount of groundwater in storage that may be available to a well is an important consideration because there will be times when recharge yields little to no water to the aquifer.

As groundwater supply wells produce water during drought periods when little recharge can occur, the majority of groundwater will be provided predominantly from storage. For that reason, it is reasonable to estimate the carrying capacity of land, based both on periods when recharge may not be occurring, and for periods when average recharge rates are potentially occurring. As described above, because the hydrogeology of the East Mountain Area is so complex and variable, the following discussion is a generalization, and site specific hydrogeologic studies are needed to define the local availability of groundwater.

The 70-year carrying capacity for lots having various saturated thicknesses, without recharge, and with an average recharge of 0.4 inches per year are provided in Appendix D Tables 3 and 4, respectively. Actual recharge values will vary with time and location and will affect the applicability of Appendix D Tables 3 and 4. As noted in Appendix D Tables 3 and 4, the assumption that recharge occurs equally throughout an aquifer allows smaller lots to be developed. The 100-year carrying capacity would require proportionally larger lot sizes, or an increase in lot sizes by about 40 percent.. Appendix D Tables 3 and 4 are generalizations regarding sustainability and lot size based entirely on East Mountain area aquifers. It does not account for the importation of additional water supplies from other areas such as the Estancia basin. Use of such "external" resources may allow more intense development to occur.

Of course, the estimated lot sizes listed in Appendix D Tables 3 and 4 are generalized estimates for the East Mountain Area and the values would change if the assumptions were different. As suggested in Appendix D Tables 3 and 4, when a lower recovery factor is assumed, a greater saturated thickness or larger lot sizes is required to provide a 70-year or 100-year water supply. Additionally, if regional water level drawdowns were occurring in a specific area, the rate of decline would need to be factored into the availability of groundwater. Alternatively, when the specific yield of the aquifer is greater, or if the recharge rates are greater, a lower saturated thickness or smaller lot sizes are able to provide a 70-year or 100-year water supply. The specific yield values presented in Appendix D Tables 3 and 4 represent a typical value (0.01) and a value at the upper end (0.05) of the reported values for the aquifers in the East Mountain area. A specific yield value of 0.05 is not representative of the majority of the aquifers in the East Mountain area and may be overly liberal to use in planning considerations; it has been included primarily for comparison purposes.

For Appendix D Tables 3 and 4, potential return flow to the aquifer from outside irrigation or from septic fields is assumed to not occur. The assumption of available recharge in these situations is that only the recharge that falls on the lot is available, and that recharging water upgradient from the lot would be unavailable or captured by upgradient households. Consequently, recharge occurring on federal lands, or other undevelopable lands, should not be used to justify the development of smaller lot sizes unless detailed site specific hydrogeologic studies can quantify recharge and discharge areas from the adjoining federal or other undevelopable lands. These types of studies may include water quality sampling to date the age of the water, pumping tests using observation wells to better define the hydraulic properties of the aquifer(s), and groundwater flow modeling to assess impacts on other wells and areas as a result of intercepting the recharge.

One of the important issues included in the study by Molzen-Corbin & Associates and Lee Wilson & Associates was the issue of well construction in the East Mountain Area. They note that although community system wells are constructed such that the intake portion of the well is relatively deep, yet domestic wells are sometimes only drilled tens of feet (20 to 30) below the water table. This is problematic not only because shallow wells are typically more susceptible to contamination, but also because local and regional water level fluctuations might result in the water level in the aquifer declining to levels below which water can be produced from shallow domestic wells. Additionally, conditions of partial penetration of a well through an aquifer may also reduce the well efficiency and further increase drawdowns in a given well,for a given yield. Balleau and Silver (2004) discuss domestic well construction and suggest that some of the considerations for domestic wells and their depth include: declines in water levels due to interference from other wells, declines in water levels due to natural declines associated with drought, and pump-induced drawdown (dynamic drawdown), the depth of which is determined by the well efficiency. In short, domestic wells which are completed to greater depths are generally less susceptible to water level fluctuations and impacts from existing, or future, nearby wells.

Appendix D Tables 3 and 4 reflect minimum lot sizes required based on various groundwater conditions in the East Mountain area and assuming that only groundwater from within the area is used to ensure water availability. The tables do not reflect the impact of using imported water from other areas. Imported water from outside the East Mountain Area is currently used, and is committed for future use, to provide supplies for subdivision and other uses. Water rights from suppliers importing water should be dedicated to specific subdivisions to ensure that the water rights will not be used for other areas or purposes. Suppliers should quantify their existing water rights commitments (at full build out) for a 70-year or 100-year period. Water providers should also be required to prove they can physically produce the needed water for a minimum period of 70 or 100 years. Minimum lot sizes for subdivisions where imported water will be used as the supply should be based on the current available water rights and physical supply of the water provider. Acceptable water use calculations should be developed to determine the requirements for all subdivision uses and be compared with the proposed water providers water rights and water supply. The quantity of proven available water can then be used to determine the permissible number of lots (and hence the minimum lot size, but only if the total area within the subdivision is held constant). However, the proven quantity does not, in itself, dictate a given lot size. Assuming water availability from providers outside the area is not an issue, minimum lot sizes may ultimately be based on lot size requirements for septic systems.

A major issue that affects lot size is the issue of on-site waste water disposal, and how large a lot needs to be such that groundwater contamination from these systems can be limited. State and county regulations have charted methods to determine lot sizes appropriate for different environments, and must be consulted if on-site waste water disposal is being considered. Lot sizes in those situations, are based on such factors as the ability of the soil to absorb the effluent, the degree of fracturing, or cracks, in the rocks, the amount of waste water that will be disposed of on site, the depth to water in the area.

Determining an appropriate lot size for the East Mountain Area is complex and largely site-specific. It is beyond the scope of this plan to designate lot sizes for specific regions of the East Mountain Area. The aforementioned discussion does, however, provide guidance as to what type of information should be considered and further developed as part of the on-going County water resource investigations in the East Mountain area.

Groundwater Administration

The NMOSE regulates water rights, appropriations, community water system permits, and private domestic well permits. Map 7 shows the NMOSE declared groundwater basins in the East Mountain Area of Bernalillo County. Under current law, the NMOSE must grant a domestic well permit to any applicant. A domestic well permit is not a water right that can be bought or sold. Rather it is only a right to use water at the location where the permit was granted. A domestic well permit typically allows for the use of up to 3 acre-feet (ac-ft) of water a year (977,550 gallons), as is allowed for the Rio Grande Basin portion of the East Mountain Area. However, NMOSE-reports, which detail groundwater withdrawals throughout New Mexico, indicate that domestic well withdrawals generally range from about 0.25 to 0.35 acre-feet per well per year (81,463 to 114,048 gallons per well per year).

In the Estancia Basin, which covers the easternmost part of the Bernalillo County, the NMOSE has designated a Critical Management area. New domestic wells in the Critical Management Area of this basin will only be granted a half acre-foot per year for domestic water rights. (Estancia Underground Water Basin Guidelines for Review of Water Rights Applications, NMOSE, June 20, 2002). In the East Mountains, water use from domestic wells appear to be typically much less than 3 acre feet per year, in large part because of well capacities, but also because households do not typically have extensive outdoor water usage. The NMOSE has estimated domestic well usage to range from about 0.25 to 0.35 acre-feet per year (Wilson et al, 2003). Current consumptive use in the East Mountain Area is estimated by water suppliers at approximately 0.30 ac-ft (about 100,000 gallons) per household per year. Current usage patterns suggest that impact of any NMOSE-mandated consumptive use restrictions for domestic users would likely be minimal.

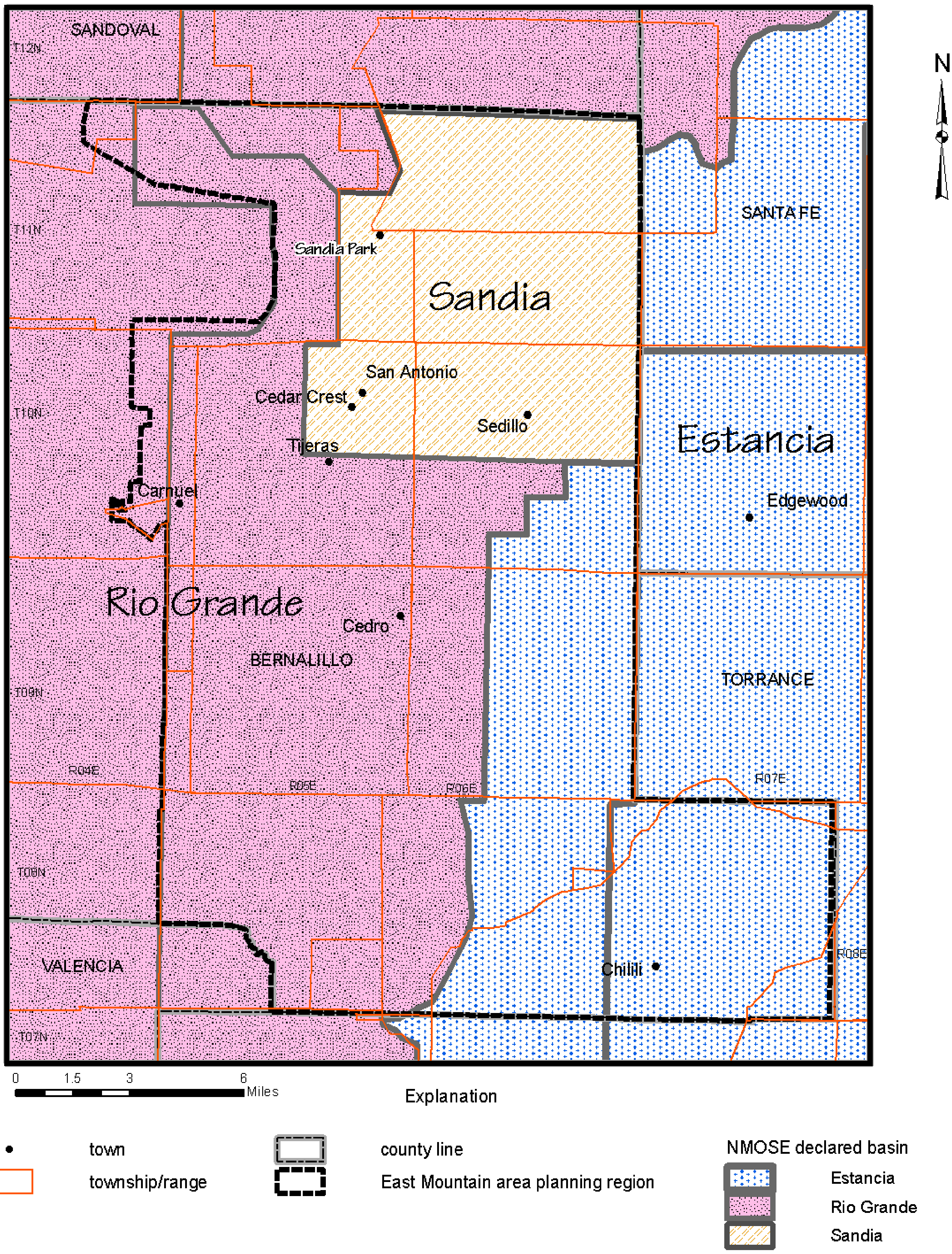
Water Problems

Most of the wells drilled in East Mountain Area have been low-yielding, providing adequate quantities only for domestic use. The permeability of most of the water-producing strata (or aquifers) is such that they do not yield enough water to be economically used to supply centralized community systems. There are presently 15 community water systems providing service to the East Mountain Area including mobile home parks, mutual domestic water associations, utilities, and other water providing associations. Entranosa, one of the larger community water service providers, has wells in Santa Fe County but services many Bernalillo county residents, and is therefore included in the count. (Source: personal communication with Kevin Cooke, New Mexico Environment Department (NMED) Drinking Water Bureau, May 28, 2004)

Water problems described by 394 respondents in the 2003 community survey include water quantity, water quality, water distribution, cost, and system management. About 33.3 percent of the respondents to this question reported water quantity problems – the water levels in their wells are dropping or going dry, or they have low pressure in their water system. They generally attribute these to "over-development," and not the recent drought, and would prefer to see development controlled, especially consumptive uses such as non-native vegetation and golf courses, etc. rather than solving the problem with a new water supply from elsewhere.

In the 2003 East Mountain Area survey, four out of 350 people who responded that they had water problems, stated that their wells dried up, and 21 had noticed a definite drop in well water levels. It is difficult to determine whether this is due to recent droughts or more claims on the groundwater resources.

Map 7



Map showing the New Mexico Office of the State Engineer declared groundwater basins in the East Mountain Area, Bernalillo County, New Mexico.

JOHN SHOMAKER & ASSOCIATES, INC.

Residents living in the East Mountain Area for more than 5 years are more likely to have water quantity problems. This may be due to the increased number of domestic wells in proximity to one another. It may also be due to the fact that precipitation in the last few years has been lower than the historic average. Water quality problems (27 percent) including hardness (minerals), taste, and smell were more likely to be reported by survey respondents who have been East Mountain Area residents of less than 5 years. Nine percent of those answering this question had water distribution problems, nine percent had cost problems, and four percent had system management problems. A vast majority of survey respondents still do not want to address water problems with area-wide systems because of concerns regarding rapid growth. There are numerous water-quality improvement options available to residents and community systems, which could be the basis of a growing economic sector in the East Mountain Area. Such problems can be efficiently addressed on a case-by-case basis utilizing point-treatment with osmosis, filters, etc.

WASTE WATER

The human-occupied East Mountain Area began as a rural area with widely scattered housing, so it was natural that every building had its own septic tank and disposal field. As the area develops and housing becomes more densely clustered, it becomes problematic for everyone to have an individual liquid waste system. It is difficult to detect septic system problems, until the waste water backs up to the surface, invades a neighbor's well or one's own becomes contaminated Disposal fields must have enough area for waste water to percolate through the soil and prevent infiltration of contaminants before they reach the homeowner's well or migrate to a neighbor's well through the aquifer. In the 2003 community survey, only 4.3 percent (29) of those who responded to this question thought that they had waste water problems or were concerned about the issue. Residents should be encouraged to consult local purveyors of new technologies for upgrades to their systems whenever possible.

There are several waste water treatment options appropriate to the rural mountain area, as treatment plants and major sewer systems are impractical in this area. Most East Mountain Area residents use septic systems, which may or may not have additional treatment attachments; constructed wetlands or other community treatment systems; composting, electric, or incinerating toilets; and graywater systems. The last two are used in combination with another system, as neither can treat all domestic waste water. Non-discharging systems are an expensive alternative. With the broader application of new technologies and knowledge, a fledgling maintenance and supply industry could potentially develop in the East Mountain Area, providing jobs to local residents.

Sewers are not likely to be installed in the East Mountain Area due to geologic limitations, but community liquid waste systems may become more common as development increases. Community systems are required in new subdivisions with small lot sizes, because individual waste water systems are not currently permitted on new lots less than ¾ acre in size, due to their inability to meet the new waste water performance standards. Existing systems on small lots will still need to meet Class 2 or 3 performance standards. The New Mexico Environment Department (NMED) Construction Programs Bureau can assist in identifying possible funding sources for assistance to owners of poorly performing septic systems and implementation of small community systems that they call the "Decentralized Approach to Waste water Management."

Residents who are concerned about needing to replace their existing septic system by 2015 due to the 2000 Bernalillo County Waste water Ordinance do not necessarily need to be alarmed, as long as their system meets the current waste water performance standards. Rather than spending funds on enforcement of its standards, Bernalillo County is encouraged by the residents to provide economic assistance and incentives to owners of problematic systems. Residents are encouraged to apply for a free waste water permit to help document the existing systems in the East Mountain Area. Anyone who has an "alternate system" (anything other than a septic tank/drain field) needs to have a maintenance contract, as most residents are not qualified to clean filters, check blowers, or do other preventative maintenance to keep an alternate system operating properly. A maintenance sector of the economic community can develop (as it already has for air conditioners and heaters, etc.) as the new septic system technology sector develops. There are also additional requirements for custom or experimental systems using technology not considered "off-the-shelf."

The major factors that influence the success of a simple septic system are the type of soil in which the drain field is located, how the drain field is constructed, and the depth to bedrock. Drainage pathways and site slope are also factors in its success. As development continues in the East Mountain Area it is becoming apparent that the most desirable parcels with respect to easy disposal of waste water have been developed. Many of the undeveloped parcels have poor quality soil and/or lack in soil quantity. Future residents need to be informed about this fact by the persons selling the land.

Soils

One of the more severe environmental limitations to development in the East Mountain Area is the soil type and conditions. Most of the soils in the East Mountain Area pose severe limitations for the development of simple septic tank disposal fields. Even though the most glaring impact of soil limitations is on liquid waste disposal, quite a few of the soils in the East Mountain Area have characteristics that require the modification of site or design and construction of roads, buildings, and other features of new development. The Ciudad Soil and Water Conservation District has provided Bernalillo County with a detailed analysis of the soil types existing in the East Mountain Area, limitations associated with those soils, and recommendations concerning septic tank disposal fields and drainage velocities. This report is included as Appendix E.

Soils in many parts of the East Mountain Area are subject to severe erosion. The characteristics of the soil, steepness of slopes, and the potential for artificially increased runoff from development significantly increase the potential for soil erosion. Recent research has developed many innovative ways to "develop" lots that minimize possible runoff and enhance infiltration instead.

In summary, the soils in the East Mountain Area can represent a significant constraint upon development. The soils on each development site in the East Mountain Area must be taken into consideration by Bernalillo County, the landowner and the builder in order to ensure that appropriate siting, excavation, construction, landscaping and non-polluting waste water systems are installed.

Drainage

As discussed previously, in the Surface Water paragraph, East Mountain Area streams are few and limited in length, surfacing at springs and flowing only short distances before drying up through infiltration or evaporation. Many of the streams are located in the higher elevations on Forest Service land and are most often found in the form of intermittent streams running only during periods of high precipitation.

The area does receive significant amounts of precipitation through snowfall, and during the summer rainy season. Extensive site grading and the removal of vegetation can contribute to erosion and the potential for flood damage to property. Site development must be sensitive to the periodic high flows of snowmelt and thunderstorms, and appropriate drainage solutions including sediment transport analysis must be included in all development plans.

Multiple use of drainage areas should occur wherever possible; that is, arroyos can provide corridors for adjacent recreational trails, open space connections, and stormwater flows. When feasible, arroyos should be left in their natural state to help maintain the rural character and natural environment of the area. Future trail locations in conjunction with arroyos shall be coordinated with drainage requirements to ensure safe horizontal and vertical clearance between the trails and the arroyos. Due to potential flash flooding in natural arroyos (where the people in the lower reaches may not be able to see a cloud burst in the upper reaches of the drainage basin due to the topography), it is imperative that all trails be placed at an elevation which is above the water surface during a 100-year storm event plus the desirable freeboard. Additionally, due to the wave action in the natural arroyos, a prudent buffer or adequate horizontal and vertical clearance between trails and arroyos should be provided.

Drainage criteria for development follow the County Drainage Ordinance (96-5) and the City of Albuquerque DPM 22.2 for technical guidance. Generally most residential development within the East Mountain Area does not require a grading and drainage plan being submitted to County Public Works. Residential property is required to develop no more than 15 percent of the property or the County Drainage Engineer may require a grading and drainage plan. Most commercial development, however, does require a grading and drainage plan due to the significant increase in stormwater runoff. Commercial development requiring a grading and drainage plan will usually have to pond the developed flows for the 100 year 10 day storm in a retention pond and the 100 year 6 hour storm in a detention pond. A retention pond has no outlet, and a detention pond has an outlet pipe that meters flows out during and after the storm event to reflect undeveloped conditions. Ponds may not be necessary when the development can show downstream capacity to handle the increased flows. This usually is accomplished by discharging into one of the major arroyos that have the capacity and armoring to handle large flows. Large arroyos consist of the Frost, San Pedro, Armijo, San Antonito, Tijeras and Cedro. The San Antonito and the Tijeras arroyos follow North 14 and Route 66 respectively, where most of the commercial development has taken place.

Slope

The East Mountain Area is located on the eastern slopes of the Sandia and Manzanita Mountain ranges. The northern portion of the Manzano Mountains and Monte Largo portion of the San Pedro Mountain Range are also included in the East Mountain Area. From the highest elevation in the northwest corner of the East Mountain Area, the terrain slopes eastward toward the Estancia Valley. The elevation at the highest point is 10,678 ft at Sandia Crest and in two places descends to a low elevation of 6,000 ft along Interstate 40 on Tijeras Canyon in the vicinity of the Village of Carnuel, and south of Mount Washington near North Canyon at the southwestern corner of the area, for a total elevation change of 4,678 ft.

The East Mountain Area can be characterized as generally steep in slope, which range from 0 – 10 percent, 10 – 20 percent and above 30 percent (See Map 9). These slopes are generally significant since the greater slopes will cause a greater amount of runoff during a storm event. As a result of the slopes in the area, the runoff will generally make its way to the Tijeras Arroyo running along Interstate 40 or the San Pedro and Frost Arroyos that flows to the east and parallel Frost Road.

Slopes of above 30 percent occur much less frequently and are found mostly within the Forest Service areas in the Sandia Mountains. Slopes of this degree are also found in the Forest Service area in the Manzanita Mountains.

Slopes of 10 – 30 percent occur near the bases of the foothills and valleys in small- to medium-size pockets, which are scattered over the entire area. Larger areas in this slope range dominate the landscape as the influence of the steeper mountain slopes diminish toward the Estancia Valley near San Antonito, Sedillo, Juan Tomas, Yrisarri, Escabosa, and Chilili.

Slopes of 0 – 10 percent are frequent and exist in pockets north of San Antonito along State Highway 14, northeast of Sedillo along Route 306, northeast of Yrisarri, in the vicinity of Escabosa and Chilili where several medium to large areas exist, and five areas in the Manzanita Mountains; two within the boundaries of the Cibola National Forest, and three in the Isleta Indian Grant.

Slope Development Issues

Changes in elevation provide developmental benefits and constraints to the property which include:

Creative Planning
Creative designs in residential development can utilize multiple finished floor elevations and possible walkout basements.

Views
The upper elevations have impressive panoramic views of the Sandia and Manzanita Mountains to the west, Monte Largo to the north, and the Estancia Valley to the east.

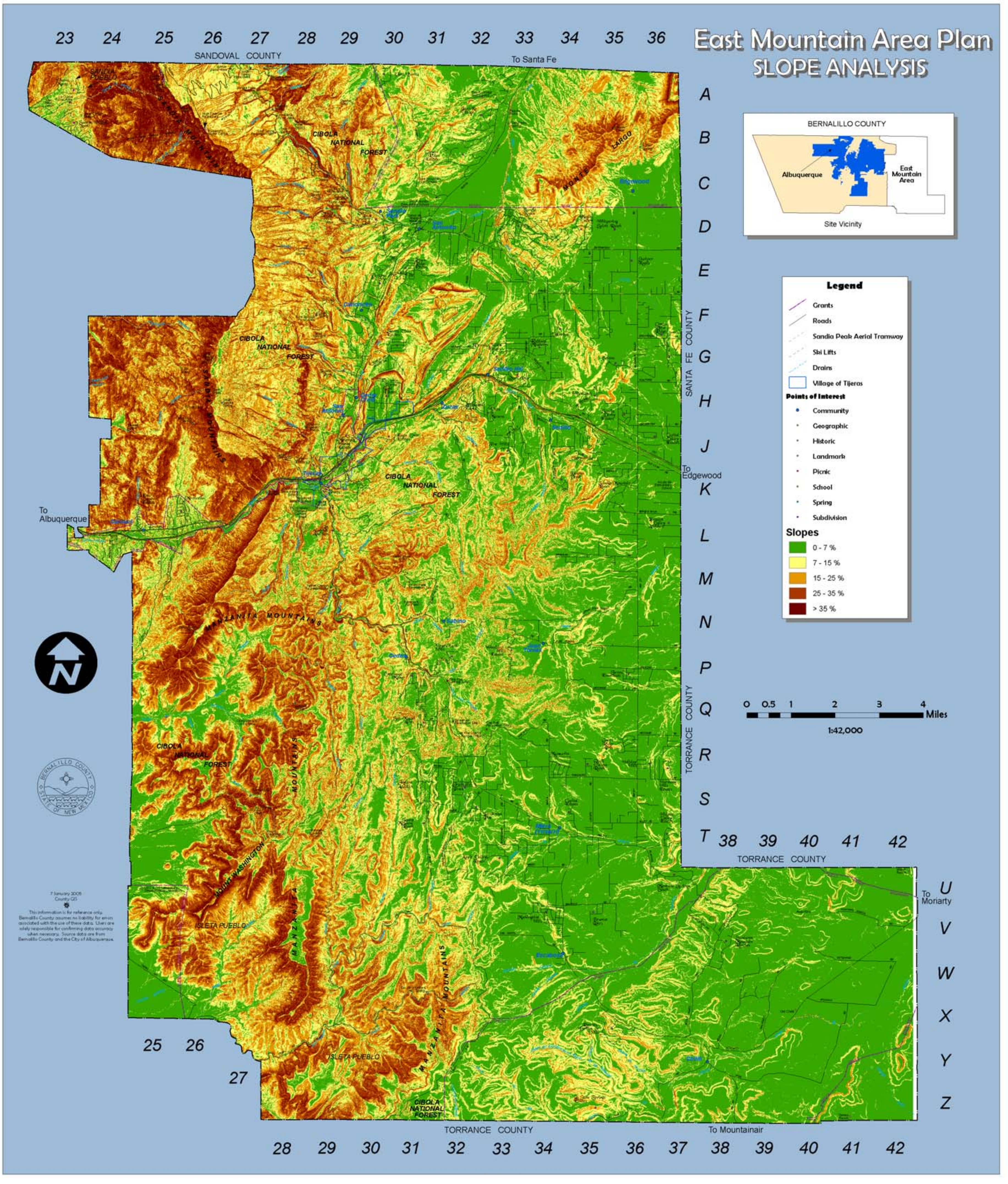
Buffering
Changes in elevation usually provide opportunities for buffering between different land uses and residential developments.

Drainage
Steeper slopes challenge future development with the need for creative design solutions. Soil stabilization features include rock rip rap, shotcrete, vegetative cover, or other engineered features to reduce soil erosion. Residential development generally is required to leave 15 percent of the site undisturbed, and commercial development will generally require a grading and drainage plan to assess the drainage impacts.

Constraints

Areas where slope exceeds 15 percent are particularly sensitive environments and must be treated with special consideration. Suitable development can still occur in these areas if enough land is available for appropriate siting of buildings, minimized grading, and switchback roadways that may incorporate retaining walls. However, the higher slopes can cause problems in accessing the property during inclement weather. Hillsides in an undisturbed state maintain a stable slope as a result of the vegetation, geology, soil and precipitation. Development can easily disturb the existing balance if careful consideration is not given to planning for specific needs that protect against disruption of vegetation, occurrence of erosion, and destruction of the visual landscape.

Slope is of particular concern in the East Mountain Area because of its impact on drain-field operations and on-site waste water disposal. Slope, combined with the shallow soils, fractured bedrock, and close proximity of septic tanks and water wells, has contributed to water pollution problems in many areas. The State and County are in the process of drafting more stringent regulations governing new and existing septic tank use in the East Mountain Area, and slope will be a significant criterion for permitting in the future.


East Mountain Area Plan
SLOPE ANALYSIS
BERNALILLO COUNTY
Albuquerque
East Mountain Area
Site Vicinity
Legend
Grants
Roads
Sandia Peak Aerial Tramway
Ski Lifts
Drains
Village of Tijeras
Points of Interest
Community
Geographic
Historic
Landmark
Picnic
School
Spring
Subdivision
Slopes
0 - 7 %
7 - 15 %
15 - 25 %
25 - 35 %
> 35 %
0 0.5 1 2 3 4 Miles
1:42,000
SANDOVAL COUNTY
To Santa Fe
SANTA FE COUNTY
To Edgewood
TORRANCE COUNTY
To Moriarty
To Mountainair
To Albuquerque
CIBOLA NATIONAL FOREST
MANZANITA MOUNTAINS
ISLETA PUEBLO

VEGETATION

In both the 1990 and 2003 survey, residents indicated that vegetation both on their property and as part of the overall landscape was of high importance. In addition, in the 2003 survey, residents ranked forest health and environmental issues third on the list of concerns regarding the area.

Dominant Vegetation

Due to the varied elevation, soil types, and precipitation, there is some vegetative variation across the East Mountain Area. However, the Area is largely dominated by Piñon Pine (P*inus pinea*), Juniper (*Juniperus monosperma*), and Gambel Oak *(Quercus gambelii),* which cover many slopes and ridges and are frequently interspersed with grassland areas.

The upper elevations (7,200 – 10,000 feet) of the Sandia Mountains' eastern slopes, which are a critical watershed to the East Mountain Area, are dominated by Ponderosa Pine (*Pinus ponderosa*), Piñon Pine, Douglas Fir (*Pseudotsuga menziesii*) and Gambel Oak, with small pockets of Aspen (*Populus tremula*) occurring above 8000 feet. This area supports a more varied vegetation cover due to increased precipitation, and retention of runoff.

The east face of the Manzanita Mountains is dominated by shrubby grassland, including Fourwing Saltbush *(Atriplex canescens*), Sand Sagebrush (*Artemesia filifolia*), Yucca (*Yucca spp.*), Cholla *(Opuntia spp.),* Broom Dalea (*Psorothamnus scoparius),* Black Grama (*Bouteloua eriopoda*), Blue Grama (Bouteloua gracilis), Indian Ricegrass (*Achnatherum hymenoides*), and Dropseed grasses (*Sporobolus* spp).

The vegetation cover to the east of the Manzano Mountains is predominantly grassland with large pockets of Ponderosa Pine, Piñon pine, and Gambel Oak occurring on western slopes. Eastern slopes are a mixture of Piñon Pine, Juniper, and Gambel Oak frequently interspersed with large areas of grassland that continue toward the Estancia Valley.

There have been numerous land use practices that have altered the vegetation of the East Mountain Area over time. There is evidence that some areas were once cleared of low-lying shrubs to accommodate farming which expanded the grassland areas that naturally occur between peninsulas of ridges covered with Juniper and Piñon. Much of the area appears to have been logged according to a 30-40 year cycle, and has been heavily grazed for over a century. Logging has taken most of the older trees. Grazing has inhibited grass regeneration and encouraged the growth of woody shrubs and trees. In addition, fire suppression has lead to thick shrubby areas of similarly aged stands of Junipers, Piñon pines and Ponderosa pines. Within the last few decades the primary source of change to the vegetation in the area has been a direct result of development and the associated increase in population.

Benefits Provided by Vegetation

- A healthy vegetative cover stabilizes and enriches the soil and slows runoff from precipitation. This encourages soil absorption, reduces erosion, and encourages aquifer infiltration. All these factors are essential to a healthy watershed.

- Forest vegetation moderates the effects of wind and storms, and regulates climatic extremes. Microclimates created by woodlands keep air at an even temperature partly through shading provided by trees and transpiration of water from leaves.

- The environmental diversity of woodlands is an important resource for wildlife conservation, environmental health, and recreation.

- Vegetation buffers the sights and sounds of development, mutes noise from freeways and factories, absorbs some air pollutants, and overall improves the aesthetics of the area.

Consequences of Loss of Vegetation

- Loss of vegetative cover, along with a growing number of impervious (paved) surfaces increase runoff and decrease infiltration of precipitation back into the aquifer. This endangers the aquifer's natural cycle of regeneration and contributes to the likelihood of flooding and erosion

- The removal of vegetation from the landscape deprives the soil of the stabilizing function of roots, as well as the moderating effects on wind and water erosion. In arid areas and in regions where the soil profile is very thin, even short periods of no cover, especially during periods of heavy precipitation or snow melt, can erode enough of the soil to make replacing lost vegetation difficult, if not impossible. Once soil is displaced, sedimentation of regional water bodies can have a detrimental impact on surface water quality and soil deposition on structural facilities increases maintenance requirements for those facilities.

- Disturbance of vegetation can destroy a community's aesthetic resources. Hills, ridges, and meadows frequently mark boundaries and serve as landmarks, which provide a sense of orientation and identity for homes and other buildings in a community.

Beetle Blight/ Drought

Following the high moisture level of the 1970's, the tree densities within the East Mountain Area increased dramatically. The recent drought conditions and greater number of trees competing for limited water resources has made the Ponderosa pine and Pinion pine trees more susceptible to bark beetle infestation. Bark beetles attack trees that are weakened or dying due to stress factors such as drought, disease, or alteration of the water table. Bark beetles bore through the bark to the cambium layer of host trees. In healthy pine trees, resin oozes from the bark where beetles first attack, producing pitch tubes. Beetles become trapped in the pitch and die. Trees within drought stricken areas do not produce enough pitch to expel the bark beetle. Once bark beetles have colonized a tree, it cannot be saved.

Fire Safety Considerations

Wildfire is a natural occurrence in forest ecosystems. Fire suppression practices of the last 100 years have lead to increased fuel loads in forested areas. Given the sustained drought conditions and high fuel loads in the East Mountain Area, once a fire ignites the potential of it becoming a catastrophic wildfire is very high.

In the East Mountain Area, there are many wildland-urban interface areas, where structures are built in forested areas. The nature of building in forested areas puts people and their property at risk of wildfire damage. If a lightning strike or human campfire got out of control, the higher than normal tree densities and accumulation of fuels could create a catastrophic wildfire that could endanger residents and structures.

The Wildland-Urban Interface Area Inventory Assessment, published in 2002 by the Bernalillo County Fire Department and the New Mexico State Forestry division, indicated that the East Mountain Area has 23 sites that have been designated with a high fire hazard rating. This area was rated with high hazard due to the following factors: houses are built in locations that are not easily accessible to emergency operations vehicle; The majority of houses have unprotected wood decks and wood frame type construction; Much of the vegetation fuels in the area are drought stricken, insect infested, or diseased; Outside of Tijeras and Cedar Crest, there is limited water availability and water must be transported in; Access to the area consists of narrow winding roads including maintained two-lane roads, some one-lane gravel, and multiple dead-end roads; Archeological sites, US Forest Service land, and wilderness areas bound the area; And lastly, much of the heavily forested areas in the East Mountains are located on steep slopes, which aid in the spread of wildfires and add to the difficulty of fighting a wildfire. As a result of this hazardous situation, the Hazardous Mitigation Plan for the City of Albuquerque and Bernalillo County has ranked wildfire as the number one priority.

In response to the dangerous wildfire situation in the East Mountain Area, numerous agencies have been working together to reduce the wildfire danger.

Current projects include:

- Starting in 1991, the East Mountain Interagency Fire Protection Association (EMIFPA), which consists of 13 separate agencies and organizations, began working together to prepare for wildfire. Through training, education, and coordination, EMIFPA brings individuals and organizations together so they can act as one effective group in the event of a fire.
- The US Forest Service is conducting ongoing thinning projects on public lands in the East Mountains. These projects include firebreaks, thinning for forest health, and prescribed burns to lower fuel loads in that area.
- Ciudad Soil and Water Conservation District in cooperation with the State Forestry Division is managing the East Mountain Forest Health Program. Since the program's beginning in 2001, the program has helped more than 300 East Mountain landowners create wildfire defensible space around their homes. The program provides cost-share funding to pay contractors to remove flammable underbrush, thin out woodlands, and build fuel breaks around their homes. In addition to fire protection, the project benefits all residents in the area by increasing the diversity of plant and animal species in the forest, reducing erosion, and increasing aquifer recharge.
- Bernalillo County and Ciudad SWCD have been working together to periodically sponsor Green Waste Days where East Mountain residents may dispose of slash from their thinning projects at the areas transfer station for free.
- The East Mountain Trails and Bikeways Master Plan identifies many future trail corridors serving as access routs for combating fires.

WILDLIFE

The wildlife within the East Mountain Area is similar to that found in other New Mexico upland and mountainous areas. The area is situated along one of the major flyways in the Americas leading to a wide variety of migratory bird species. In addition, coyotes, prairie dogs, rattlesnakes, and other mammals, reptiles, and amphibians common to upland New Mexico are found within the area.

In both the 1992 and 2003 surveys, community members commented that they appreciated seeing and living near wildlife. There are also residents in the East Mountain Area who commented that they are nervous or uncomfortable about potential animal encounters. Regardless of whether wildlife is seen as a positive or negative attribute, living within or near forested areas requires understanding risks associated with the natural environment. Residents must take sensible precautions to protect children and pets, without causing harm to the wild animals that also live there. Bear kills have occurred in the East Mountain Area in areas where people were unintentionally attracting wildlife (bird feeders, pet food, unsecured garbage cans, and water troughs), and then being surprised when drought-starved animals appeared. For this reason residents should be well educated as to what to expect and how to prevent unwanted animal encounters.

AIR QUALITY

The East Mountain Area's air quality is one of its most attractive environmental resources. While the East Mountain Area now enjoys an abundance of clean, uncontaminated air, it is important to realize that as population and associated activities increase, it will be necessary to guide land use and community development toward strategies and solutions that are respectful of this aspect of the environment.

Although limited monitoring of air pollution has been conducted in the East Mountain Area, some information is available. In the late 1970s, the New Mexico Environment Department performed some monitoring of air pollutants in the East Mountain Area at the Roosevelt Middle School located in the Village of Tijeras. Results of this monitoring showed low levels of all pollutants monitored. After monitoring air pollution for about four years, monitoring efforts were terminated in 1979 because no air pollution problems were found.

More recently, the City of Albuquerque's Environmental Health Department placed a temporary air quality monitor at the Roosevelt Middle School in the spring and summer of 2002. Pollutants monitored included coarse particulates (PM10) and fine particulates (PM2.5). PM10 is particulate matter having a diameter of 10 microns or less and PM2.5 is particulate matter having a diameter of 2.5 microns or less. Results of this monitoring showed low levels of PM10 and PM2.5. Daily averages for both PM2.5 and PM10 were generally less than 20 percent of the National Ambient Air Quality Standards.

The City of Albuquerque's Environmental Health Department also received a special grant from the U. S. Environmental Protection Agency (EPA) to perform temporary air quality monitoring in the spring of 2004. Once again, the location of the monitoring was the Roosevelt Middle School. Pollutants monitored included PM10, PM2.5, carbon monoxide, and nitrogen oxides (NOX). This monitoring showed pollutant levels well below the National Ambient Air Quality Standards indicating that excessive levels of these pollutants were not present at the school. Ozone has not been measured in the East Mountain Area; however, the Environmental Health Department has received additional funding that will allow for monitoring of ozone latter in the summer of 2004. (Results from the ozone test were not available at time of publication.)

Based upon air quality monitoring data, indications are that air quality in the East Mountain Area is generally good. Even so, other portions of the air quality monitoring network located in the Central Rio Grande Valley have measured relatively high levels of ozone and PM10 in Bernalillo County in recent years. Ozone refers to ground-level ozone. Both pollutants are regulated under the federal Clean Air Act as being pollutants that can adversely affect health. Ozone is created by a series of complex chemical reactions in the presence of sunlight and the precursor chemical compounds contribute to ozone. The precursor chemical compounds, including volatile organic compounds (VOCs) and nitrogen oxides (NOX), come primarily from motor vehicle emissions. Nearly all PM10 comes from fugitive dust (i.e. blowing dust). Due to the presence of sources of fugitive dust in the East Mountain Area, including unpaved roads and unpaved lots, localized areas may be subject to high levels of PM10, particularly during high wind events.

Air Quality Sources And Improvements

Ozone and Other Pollutants:

There are four primary categories of air pollution sources: on-road mobile, off-road mobile, area, and stationary. Like most other Western States, automobiles produce the majority of air pollution within our communities. This is probably truer in our more rural communities like the East Mountain Area, due to the minimal presence of heavy industry and large stationary sources. For example, the *Year 2002 Periodic Emissions Inventory for Carbon Monoxide* shows that highway vehicles produce 77 percent of the total carbon monoxide in Bernalillo County. Highway vehicle emissions combine with off-road vehicle emissions to produce 84 percent of the total carbon monoxide pollution. Vehicle emissions are also responsible for about two thirds of the ground level ozone pollution in Western States. Controlling pollution from motor vehicles can provide excellent air pollution reduction benefits.

Combining residential, commercial and employment centers in close proximity to each other can be an effective strategy to help reduce vehicle emissions. In the past, much of the development in the East Mountain Area had been primarily residential with most major commercial and business developments being found some distance away in Albuquerque. However, during the last few decades of growth in the East Mountain Area, more business and commercial land uses have located near and among East Mountain residential developments. This has provided more opportunities for residents to obtain goods and services closer to their homes. In addition, more employment is available closer to residential uses reducing the length of commute trips. These shortened trip lengths translate into lowered vehicle emissions of nitrogen oxides (NOX), volatile organic compounds (VOCs), fine particulates (PM2.5), course particulates (PM10) and carbon monoxide (CO) within the air shed. Reducing these pollutants helps maintain compliance with the National Ambient Air Quality Standards.

In addition to reducing trip lengths and vehicle miles traveled, other programs help reduce vehicle emissions. At the local level in Bernalillo County, biennial testing of vehicles and an oxygenated fuels program are required as part of the State Implementation Plan for air quality. The vehicle testing program helps ensure that vehicles are running properly and helps reduce vehicle emissions. In the winter pollution season, ethanol is added to fuel as an oxygenate. Ethanol-enhanced fuel helps reduce CO emissions.

At the federal level, several programs continue to help reduce vehicle and non-road engine pollution. These programs include:

It is pleasing to the senses and intellect of mankind to be able to gaze at the night sky with a minimum of interference from light pollution -----*Light Pollution Ordinance for the East Mountain Area*

- requirements relating to the manufacture of lower polluting automobiles – ongoing implementation
- requirements relating to the manufacture of lower polluting highway diesel vehicles – Year 2003 to 2007 implementation
- new low-sulfur gasoline requirements (Tier 2 Gasoline) – Year 2004 to 2006 implementation
- new low-sulfur diesel fuel requirements – Year 2007 to 2010 implementation
- new non-road diesel engine requirements - Year 2008 to 2014 implementation

Together, these programs will provide significant reductions in air pollution in New Mexico, Bernalillo County and the East Mountain Area. Because many of these programs pertain to diesel trucks, air quality improvements in the Interstate 40 corridor can be expected over the next ten years. For example the new low sulfur diesel requirement will reduce the amount of sulfur in diesel from 3000 parts per million down to 15 parts per million by the year 2010 – a 99 percent reduction. The new fuel combined with improved engine technology will eliminate most of the highly visible black soot, including approximately 90 percent of the fine particulates (i.e. PM2.5) that come from large diesel trucks. These requirements will also reduce the ozone precursor, NOX, by 95 percent.

Fine and Course Particulate Matter:

Particulate matter is perhaps the pollutant of most concern for the East Mountain Area. Two forms of particulate matter are regulated under the federal Clean Air Act: fine particulates (PM2.5) and coarse particulates (PM10). Fine particulate matter is called PM2.5, meaning that these are particles that are 2.5 microns in diameter or less. Both PM2.5 and PM10 are inhaled deep into the respiratory system where they can cause adverse health impacts.

PM2.5 is caused by a number of sources such as wood burning, open burning, prescribed fires, wildfires, industrial operations, diesel engines, coal burning, and fugitive dust. Although PM2.5 levels at all Bernalillo County monitors are well within the requirements of the National Ambient Air Quality Standards, some programs have helped reduce PM2.5 emissions. A wood burning program went into effect for most of Bernalillo County in 1988. This program does not apply to the East Mountain Area, but it is believed that at least some residents voluntarily restrict wood burning when "no burn" nights are called. Because of increased efforts to use prescribed fires to create better buffers between woodland areas and residential areas, some short-term increases in PM2.5 levels may be expected in the future.

Coarse particulate matter is called PM10, meaning that these are particles that are 10 microns in diameter or less. Virtually all PM10 in Bernalillo County comes from fugitive dust.

In January 2004 the Albuquerque/Bernalillo County Air Quality Control Board, under the authority of the EPA, adopted a new Fugitive Dust Control Regulation. This regulation was issued in response to concerns about elevated levels of PM10 in Bernalillo County. The Fugitive Dust Control Regulation will begin to regulate a wide variety of sources of PM10, including unpaved public and private rights of ways, construction sites, new unpaved residential driveways serving more than 6 lots, disturbed lots greater than ¾ acres, unpaved lots, equestrian facilities, industrial or construction storage yards, and recreational areas. The regulation requires all persons to use reasonably available control measures to reduce fugitive dust from activities or land that is capable of producing fugitive dust. New unpaved roads will be prohibited beginning March 1, 2005, unless they are exempt. Potentially exempt areas include unpaved roads serving 6 dwellings or fewer, certain ranch roads, certain U.S. Forest Service Roads, and residential lots disturbing less than ¾ of an acre.

Eventually, many fugitive dust sources will become more stabilized and this will reduce PM10 levels in the East Mountain Area. This will include many of the unpaved roads within the East Mountain Area.
As Bernalillo County addresses fugitive dust issues on East Mountain dirt roads, opportunities for improving road ways (e.g. paving, striping, shoulder reinforcement) for better and safer trail and bikeways uses will be incorporated.

DARK SKIES

In 1991, the "*Light Pollution Ordinance for the East Mountain Area*" was accepted by the Bernalillo County Board of County Commissioners to create a standard for outdoor lighting. In said ordinance, light pollution was defined as "artificial light that causes a detrimental effect on the environment, interferes with the enjoyment of the night sky, causes undesirable glare, or unnecessary illumination of adjacent properties". In 1999, House Bill 39 the "Night Sky Protection Act" was enacted "to regulate outdoor night lighting fixtures to preserve and enhance the state's dark sky while promoting safety, conserving energy and preserving the environment for astrological viewing." It provided regulation for installing, or replacing public and private lighting, restricted installation of mercury vapor lighting and required the shielding for outdoor fixtures except incandescent-type under 150 watts. It also cut off event lighting after 11:00pm subject to further regulations.

With the aim to reduce light pollution, developers, businesses, and residents are encouraged to use low-pressure sodium lamps, florescent warm white and natural lamps which reduce the detrimental effects of outdoor lighting, such as intensity and color. In addition, residents are encouraged to use motion sensors on frequently used outdoor lights.

All new outdoor lighting installations (public and private) must meet the specifications outlined in the Lighting Ordinance, with the guiding intent being to exceed the expectations of the community. Existing lighting shall be reduced to meet the specifications in the ordinance, preferably with the assistance of incentives rather than "enforcement".

VIEW PRESERVATION

The dynamic mountainous landscape of the East Mountain Area provides many prominent views that are highly valued by residents and tourists alike and serve to enhance the rural character. To the north and west are views of the Sandia Mountains and Monte Largo. From some areas, views continue to the Sangre de Cristo Mountains approximately 50 miles to the north. There are significant views of the Manzanita and Manzano Mountains to the south and southwest, and of the Estancia Valley to the east.

Upper elevations provide many impressive panoramas that usually include all or most of the geographic features of the area. Middle elevations also offer many views of great scenic beauty in which V-shaped canyons, grasslands and meadows, and broad, shallow, dry washes in the middle landscape are juxtaposed against backgrounds of mountain peaks and ridges. Lower elevations offer monumental views of the mountains from clearings, meadows, and grassland areas. Sandia Crest (10,678 feet) and Manzano Peak (10,098 feet) - the highest points in the area - are the major focal points that are visible from most elevations and directions. Another important natural landmark is Cedro Peak (7,767 feet), which is visible from I-40 near the village of Tijeras.

In addition to the larger panoramic views, local meadows, structures, forests, stream courses, and drainages, particularly at major road intersections, are key elements of the valued rural character. Open meadows and grasslands, most of which are privately owned, provide visual relief and a "sense of openness" for the community. However, due to the open landscape, much of which is privately owned, the natural scenic quality of the East Mountain Area is vulnerable to significant impacts from development.

NOISE POLLUTION

Due to the low-density rural nature of the East Mountain Area, there is a quietness that differentiates it from urban areas. One of the elements of satisfaction most frequently referenced by survey respondents with respect to the East Mountains is the quiet. Also in the survey, residents mentioned concern and dissatisfaction about noise pollution associated with the sound of barking dogs and traffic including semi-trucks, motorcycles, and ATVs. Increased enforcement of the animal control ordinance and of the law making unlicensed vehicles such as dirt bikes and ATVs on roadways illegal would improve the community's overwhelming desire for a quiet rural atmosphere.